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CHEMISTRY AND METALLURGY.

JOPLIN CITY WHITE LEAD WORKS.

BY ERASMUS HAWORTH.

The visitor to Joplin City, Mo., should not fail to see the white lead manufacturing establishment of that city. For centuries past white lead has been used very extensively in almost all kinds of paints. The process of its manufacture, until within the last few years, has been very simple in practice, although a little complicated in chemical action. The oldest process of which we have any account consists simply in hanging spirally-shaped strips of sheet lead over open vessels of fermenting vinegar. In a few days the strips of lead become covered with white lead. This is then scraped off, the strips replaced over the vinegar, and thus the operation repeated indefinitely.

The vapor of acetic acid, rising from the vinegar, acts upon the surface of the lead forming a basic acetate of lead. The carbonic oxide liberated by the fermentation of the vinegar subsequently breaks up the sub-acetate, forming as the principal resultant lead carbonate, or white lead.

Another process, similar chemically, consists in dissolving litharge (*lead oxide*) in acetic acide until the triplumbic acetate is obtained. Through the solution of this salt carbonic oxide is passed until the whole of the triplumbic acetate is converted into lead carbonate (*white lead*) and neutral lead acetate. Upon boiling the neutral lead acetate with litharge more triplumbic acetate is produced, so that, with the exception of the unavoidable loss in the manipulations, a given amount

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of acetic acid will serve in manufacturing an indefinite amount of white lead. Until quite recently all of the white lead used in the arts has been made by one of these processes.

A few years ago a gentleman from Philadelphia, Mr. E. O. Bartlett, came to Joplin city professing to have patented a process by which great quantities of white lead could be saved from the vapors that escape up the flues of the smelting furnaces. His scheme was so plausible that he prevailed upon the smelting firm of Moffit & Sargent to give it a trial. It proved to be a great success. In a short time Mr. Bartlett sold his interest in the establishment and his patent right on all the territory west of the Mississippi for $150,000. New and more commodious buildings were subsequently erected, and at the present time lead smelting and white lead manufacturing are conducted on a grand scale. To give the reader some idea of the work now done by this one firm I insert the following figures given me by Mr. J. H. Black, the foreman:

Average amount of ore (*lead sulphide*) smelted per day . . 90,000 lbs.
Average per cent. of metallic lead obtained from same . . . . 66⅔ %
Average amount of metallic lead from slag resmelted . . . 14,000 lbs.
Average amount of white lead per day . . . . . 16,000 "
Average price per thousand for same $50

It will thus be seen that the average proceeds per day from the white lead alone is $800, or about $250,000 per year. I also learned that the pig lead obtained from the slag furnaces more than paid all expenses of the whole establishment, so that the 16,000 pounds of white lead and the profits on the 90,000 pounds of ore smelted are clear gain.

The smelting furnaces of Joplin city and Short Creek lead mines are all very much the same. They closely resemble the old Scotch hearth excepting instead of having flues three miles long to catch the escaping vapors, as the Scotch hearth is said to sometimes have, the flues are vertical and comparatively low. The furnaces are about twenty-two inches square and nearly the same in depth. A cold air blast, the force of which the workmen can regulate, is sent into each furnace to increase the draught. The bottom part of the furnace is left filled with lead from day to day. The smelting process is briefly as follows: Charcoal and ore, mixed with a little slaked lime, are thrown into the furnace. A heavy blast of air is turned on and roasting is continued for some time, during which the workmen are continually stirring the whole mass, and shoveling out the slag that is formed from the lime and the silica that is mixed with the ore. During the roasting the sulphur of the ore is oxydized into sulphurous oxide, which passes up the chimney. The lead is oxydized into litharge, or lead oxide. After the stirring has been continued for a few minutes the blast is almost entirely turned off, fresh charcoal is added, and the whole is heaped up at the back side of the furnace where it is left for a few minutes. The lead oxide formed is thus brought in contact with carbon which deprives it of its oxygen, leaving metallic lead

which flows off through the grooves in the iron hearth, and is finally caught in appropriate vessels.

The smelters at the white lead works are the same as at other places with one exception. Here comes the patented process. The furnace chimneys are so built that they all lead into a very large sheet iron pipe about three feet in diameter. Everything that passes up the chimney is conducted into this large pipe, which is about 200 feet long. At the other extremity of this piping is a large brick building technically called the "blue room." This building is about 100 feet long and 50 feet wide. It is two stories high, the upper story being about 35 feet while the lower one is but 12. In the upper story, hanging vertically, are 772 cylindrical woolen bags about fifteen inches in diameter and 32 feet long. In the lower story, running the entire length of the building, are four rows of "hoppers," so called from their resemblance to grain hoppers in flouring mills. The top of each "hopper" is about ten feet square, and is fastened to the under side of the second floor. The woolen bags in the second story open directly into these hoppers, the bottoms of which are opened and closed at pleasure by appropriate slides. All of the condensed vapors, mixed with a good deal of soot, having traversed the large pipe are caught by the woolen bags from which it falls directly into the "hoppers" below. After a sufficient amount has been collected—which requires about two weeks time—the slides at the bottom are drawn and the mass runs out upon the floor. This mixture is as fine as flour. It consists mostly of soot and lead sulphate; a small per cent is lead carbonate. The black soot gives the whole mass a blue color, hence the name "blue room." From this room it is taken to the slag furnaces where it is mixed with slag from the smelting furnaces and again subjected to an intense heat. Fluor spar (*calcium fluoride*) is from time to time added as a flux, the slag being a basic silicate.

The flues of the slag furnaces lead into a small brick chamber, the walls of which are six feet thick. On account of the great heat in this chamber its walls are lined with fire brick. From it the vapors are forced through long pipes similar to the one which connects the smelting furnaces with the "blue room." From these pipes it is led into a large building called the "whiting room." This building is arranged very similarly to the "blue room" excepting that there are commodious arrangements for catching the white lead when it is run out from the "hoppers." The first impression upon entering this room is that one is in a large flouring mill; everything seems to be covered with flour. From this room the white lead is packed for shipment. The whole scheme is a grand one. Chemically, there is nothing new about it; mechanically, it is entirely novel.

In the process of smelting a portion of the metallic lead is vaporized. Subsequently this vapor is oxydized, and, being in contact with so much sulphurous oxide, the heat being very great, lead sulphite is formed which is soon oxydized into sulphate. In the slag furnace the whole is again reduced to metallic lead, but, on account of the superior heat of this furnace—the fire being made from coke—the greater portion is again vaporized and oxydized. The temperature is so high that the formation, or even the existence, of the carbonate is impossible,

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while the contact of lead oxide with sulphurous oxide in the presence of free oxygen is favorable to the formation of lead sulphate. The brick chamber above described also plays an important part. It helps to maintain a high temperature until the whole of the carbonaceous matter is completely oxydized, thus preventing the passage of soot into the "whiting room."

This, then, is the one and only difference between the Joplin City white lead and other white lead of commerce. The one is the sulphate of lead, the other is the carbonate.

As before stated, the white lead alone is an actual saving of about $250,000 per year. This is the only establishment of the kind in the world. Within the last few months Mr. Moffit has refused a million dollars for his works. He could find no better investment for his money, and why should he sell? He holds the right to establish other works at such high figures that none have thought it prudent to invest.

I believe Mr. Moffit has never carefully considered the great wrong he is doing the world by withholding a process by which so much might be saved, not made, but *saved* from actual loss. At horse-racing and at cards money is not lost, but only passes from one hand to another. The same is true of many *un*necessaries of life. But here there is an actual loss. The fumes of sulphur and of lead that pass up the chimney can never be regathered. At the other smelter at Joplin City and the one at Short Creek alone, this loss amounts to more than $1,000 per day; enough to feed all the hungry and clothe all the poor in the States of Missouri and Kansas. In other lead mining regions the loss is proportionally great. One thousand establishments of this kind would *save* enough to bear all the expenses of our government.

SIMPLE TESTS FOR WATER.

The following simple directions, by means of which any sample can be examined as to its suitability for use or otherwise, are from Napier's Art of Dyeing:

To ascertain if water is hard or soft.—Procure a small quantity of soap dissolved in alcohol (soap solution for this purpose can be obtained from any operative chemist), and let a few drops of it fall into a glass of the water to be tested. If the water becomes milky it is hard, but if little or no milkiness results, the water may be said to be soft.

Test for acid.—Take a piece of *blue* litmus paper (unsized paper stained with litmus), or paper stained with syrup of violets or scrapings of radishes, and immerse it in the water to be examined. If any free (uncombined) acid is present in the water the paper will become red. If a little lime water, added to the sample causes a white precipitate to take place, the acid is carbonic acid. If dark blue paper, such as is wrapped around loaves of sugar, be converted to red by immersion in the water, the acid is a mineral acid.

TESTS FOR ALKALIES OR ALKALINE EARTHS.—Take a piece of *red* litmus paper (blue litmus paper that has been reddened by means of vinegar or other weak acid), and immerse it in the water. If the blue color of the paper is restored then the water contains either a free alkali or alkaline earth. If the blue color disappears from the paper after a short exposure to the atmosphere the presence of "volatile alkali" (ammonia) is indicated. If a little syrup of violets is added to water which contains a free alkali or alkaline earth it will become green.

TESTS FOR IRON.—To a glass of the water add a few drops of infusion of nutgalls, or suspend a nutgall in it, by means of a thread, for twenty-four hours. If iron be present the water will become of a dark brown or black color. Yellow prussiate of potash (Potassium Ferrocyanide) is a still more delicate test for detecting iron, If a crystal, or a drop of its solution in water, be added to a glass of water containing iron, it will immediately become of a blue color.

TEST FOR CHLORIDES AND SALTS OF HYDROCHLORIC ACID.—Let a few drops of nitrate of silver solution fall into a glass of the water. If a milkiness be produced, which disappears on the addition of a little ammonia solution, it may be concluded that chlorides or some salts of hydrochloric acid are present. (Hydrochloric acid was formerly called muriatic acid). Chloride of calcium, chloride of sodium (common table salt), and chloride of magnesium are most commonly to be met with in spring water.

TEST FOR MAGNESIA.—Take a quantity of the water and boil down to one-twentieth part of its bulk. Drop a few grains of carbonate of ammonia into a small glass of the water, and add a small quantity of phosphate of soda; if any magnesia be present it will fall to the bottom of the glass as a white precipitate.

For this experiment the carbonate of ammonia must be in a *neutral* state; if exposed to the air this salt rapidly becomes acid.

TEST FOR FREE LIME.—Into a glass of the water drop a crystal or two of oxalic acid. If a precipitate takes place, and if another glass from the same sample becomes milky upon blowing air from the lungs into it through a quill or glass tube, the presence of free lime or baryta may be inferred. The latter has never been found *free* in water.

TEST FOR CARBONIC ACID —Take a quantity of the water and add to it an equal quantity of perfectly transparent lime water. If carbonic acid be present, either free or combined, a white precipitate immediately appears, which, on adding a few drops of hydrochloric acid, is dissolved with effervescence.

TEST FOR ANY COMBINATION OF SULPHUR.—Put a little mercury into a vial filled with the water to be tested, cork it, and let it stand for a few hours. If the surface of the mercury has acquired a black appearance, and a blackish powder separates from it on shaking the vial, the presence of sulphur may be inferred.

TEST FOR LEAD.—To a little of the water in a glass add an equal quantity of sulphureted hydrogen solution (water impregnated with hydrogen sulphide gas). If lead be present the water will assume a dark brown or blackish tinge. Lead may also be detected by adding a little of a solution of sulphide of potash, or sulphide of ammonia; a similar effect will take place if lead be present.

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TEST FOR COPPER.—Immerse a polished plate of iron in the water to be examined, and let it remain for a few minutes. If copper be present, the plate of iron will be coated over with copper. A few drops of ammonia solution will turn water containing copper a dark blue color.

For all domestic purposes soft water should be preferred, and that which is clear and with little or no taste. But mineral water (water in which mineral matter is dissolved) is less dangerous than that in which organic and animal matter is contained, as this is the common source of most of our infection diseases—typhus, scarlet-fever, etc. One of the readiest and simplest tests for ascertaining if water is free from organic pollution is to cork up a small bottle nearly full of it, in which a piece of lump sugar has been put. If, by thus excluding the air and letting it stand in the light for two or three day, there is not a milky cloud, but the water remains clear, it may be considered free from the phosphates which are always present in sewage water.—*Boston Journal of Commerce.*

CONCERNING FLUORINE.

It was known nearly two hundred years ago that glass could be etched by exposing it to the fumes produced by the action of sulphuric acid on the mineral called fluor-spar; but it was not until the present century that the nature of the chemical reaction in the process was understood. Until the time of Ampère's investigations, in 1810, it was supposed that the acid attacking the glass was an oxygen compound; but that chemist showed, as Davy subsequently did, that the acid was analogous to hydrochloric acid, being a compound of hydrogen with an element existing in the fluor-spar in combination with calcium. This element was named *fluorine*, and the fluor-spar, formerly known as fluate of lime, was designated as fluoride of calcium.

This fluorine is interesting from the fact that (setting aside certain "new metals" whose oxides have been "discovered" within the last few years, but whose existence is still hypothetical) it is the only element that has not been isolated. Many attempts have been made to obtain it in its simple form, but without success.

It is easy enough to decompose its compounds, but impossible to prevent it from immediately entering into new ones. It attacks glass and the metals, so that the chemist is at a loss to find a material for vessels in which to prepare or confine it. It unites at once with platinum, which is proof against so many chemical agents. Davy heated dry fluoride of silver with chlorine gas in a platinum vessel, and got for his pains a fluoride of platinum. He tried the same experiment in a glass tube, and obtained chloride of silver, but the released fluorine attacked the glass, entering into combination with its silicon. For this latter element it has an extraordinary affinity, and its action upon glass is due to this fact. Glass is a silicate, or a compound of silicic acid with soda, lime and other metallic oxides. The fluorine decomposes the silicic acid (SiO_2), and forms with the

silicon the volatile tetrafluoride of silicon (SiF_4). Davy suggested that vessels of fluor-spar should be used for the decomposition, and the experiment has been tried; but the fluorides used were not perfectly dry, and the provoking element united with the hydrogen of the water to form hydrofluoric acid. A German scientist heated iodine with fluoride of silver in a glass tube and said he obtained iodide of silver and a colorless gas, which he supposed to be fluorine; but the English chemist Gore, who investigated the whole subject most carefully, found that perfectly dry fluoride of silver is not decomposed under a red heat by chlorine, bromine, or iodine; while if a higher temperature is employed, a fluoride of the metal—platinum, gold, silver, or whatever the vessel may be made of—is formed. If tubes of graphite or charcoal are used, a fluoride of carbon is obtained. The difficulty of making vessels of fluor-spar adapted to the purpose has prevented further experiments with that material; and for the present the chemists have to confess that they are baffled in all their attempts to isolate this singular element.

Fluorine is also unique among the elements in not combining with oxygen. It is remarkable that, with its powerful affinities for so many other elements, it should be utterly indifferent to one which is equally omnivorous in its chemical appetite.

It has just been announced by foreign journals that Loew has discovered the presence of free fluorine in a certain variety of fluor-spar, found at Wolsendorf in Bavaria. This spar is dark violet in color, and has a peculiar odor, which scientists have attempted to explain by various theories, but not very satisfactorily. Loew came to the conclusion that the odor might be due to free fluorine: and, to test his hypothesis, he ground a kilogram of the Wolfsendorf spar with water containing ammonia, using small portions at a time, the filtrate and wash-waters from the earlier being used with the later quantities. The last filtrate was mixed with sodium carbonate and evaporated; the residue treated in a platinum capsule with sulphuric acid, and, covered with a watch glass, kept at 40° to 50° C. for a long time. On examining the glass it was found to be considerably corroded. Since fluor-spar is not entirely insoluble in water, the experiment was repeated, using the inodorous mineral. The result was so exceedingly feeble as to dispose entirely of this objection to the former result.

Since the odorous spar contains cerium, Loew believes that the free fluorine is produced by the spontaneous change of ceric fluoride into cerous fluoride and fluorine. We shall want, however, to know that his experiments have been repeated and verified by others before we believe in the free fluorine or accept this theory of its origin. It would certainly be curious if an element which chemists have made so many unavailing attempts to isolate is really found free in nature under their very noses. Even if it is, the smell of it may be all that they will get in any attempt to collect and examine the gas. We shall see what we shall see, as the pious Turks say.—*Boston Journal of Chemistry.*

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"IRON SPONGE" FOR GAS PURIFICATION—A NEW INDUSTRY.

Iron sponge is a term quite unfamiliar to the average reader, although the manufacture of that article is now one of established industries of this city, and it is shipped from this point to almost every state and territory in the Union.

For the benefit of the uninitiated in the manufacture of gas we will explain the nature of the new product and its uses.

Coal gas, after being washed and condensed, remains heavily charged with impurities in the form of sulphuretted hydrogen, ammonia and carbonic acid, which must be extracted before the gas is fit for consumption, otherwise the odors emitted by the gas while burning would be unbearable.

To remove these impurities lime has—until within the last three years—been universally employed, being considered the cheapest and most effective absorbent, although its use entailed many disadvantages. As it could be used but once the rapid accumulation of "spent lime" with its accompanying odors—familiar to all persons living near gas works—necessitated hauling the same outside the city limits, in many places being an expense of no little importance.

Various experiments were made by those interested in the manufacture of gas to find an absorbent equaling lime without its disadvantages, and success was finally attained some three years ago.

Iron sponge—the term given the successful rival to lime—is obtained by treating oxides of iron in contact with carbon at a suitable heat with complete isolation from the atmosphere, and its peculiar spongy texture is caused by the loss of the volatile matter which, separating from the ore, leaves minute cells and spaces throughout its entire mass, rendering it extremely sensitive to chemical action.

After being used and becoming thoroughly saturated with impurities, it is exposed to the atmosphere for two or three days, which thoroughly revivifies it, and it is again ready for use; the same material being used over and over again for the period of from one to three years, depending upon the condition of the works, character of the coal used, etc.

The advantages claimed for iron sponge over lime are: greater economy, saving of labor, odors, etc., and it would seem not without reason, for since its introduction into the gas works of this city it has been adopted in Philadelphia, Cincinnati, Chicago, St. Louis, Kansas City, Sacramento, and scores of other works of less importance, throughout the country.—*American Manufacturer.*

PHYSICS AND ENGINEERING.

COMPASS SURVEYING.

BY FRANCIS E. NIPHER, PROFESSOR OF PHYSICS IN WASHINGTON UNIVERSITY, ST. LOUIS, MO.

Those who have had to do with the survey of land by means of the ordinary compass, do not need to be told that the field work is often attended with great difficulties. One of these difficulties arises from the daily swing of the needle. In the morning at about half past seven o'clock, the north end of the needle is farthest to the east. It then moves to the west, reaching its greatest western elongation at about one or two o'clock P. M. The average daily change in the position of the needle between these hours is fourteen minutes, or practically a quarter of a degree. This angle of swing varies, however, between eight and twenty minutes, and one can never predict what the daily swing of the needle will be. Hence, if a section line should be run in the morning, and the surveyor should attempt to retrace the same line in the afternoon, he might find the final ends of the two lines twenty feet apart.

In addition to the daily change of the needle, it is also known that the average position of the needle is changing each year. The annual change at St. Louis is now about two minutes a year, but the annual change is itself subject to change according to a law which is as yet unknown. It is assumed that the annual change is the same over large areas of the country, but it is not known that this assumption is true. On the contrary, observations made at St. Louis and near Washington, in Franklin county, during the last fifty years, lead to different values for the annual change. In addition to these changes, which are due to a change in the magnetic condition of the earth, there are other errors which are due to a change in the magnetic condition of the needle. If the true variation of the needle be known at any moment, and two compasses be set for that variation, and with the needles set on the zero of the circles, the sights of the compass would not point exactly in the same direction, nor would either of them point north and south, except by merest accident. If either compass should at some later date be again set down at the same point, adjusted again to the true variation, it would not, in general, point in the same direction as before. These differences are caused by a change in the position of the magnetic axis of the needle. The *magnetic axis* of the needle always points in the direction of the magnetic meridian (when the needle comes to rest under the influence of the earth's force alone), but the magnetic axis does not in general coincide with the geometrical axis of the magnet, and its position is changed by the shocks and jostling incident to transportation and use. These changes in the position of the

magnetic axis of a needle, are always greatest with new needles, or those which have been freshly magnetized, and hence a needle should never be remagnetized unless it is absolutely necessary. If a line be run with an old needle, and the needle is then remagnetized, the compass set to the same variation will not in general run the same line.

These difficulties in compass surveying, are the main source of the constant litigation in regard to boundary lines, and as land becomes more valuable, these quarrels will become more frequent and more expensive, until some rational method of treatment is adopted. It is not saying too much to assert that in each county there is enough money wasted each year in useless litigation over boundary lines, to pay for the permanent establishment of a true north and south line, which would at once settle most of these difficulties. This meridian line being once determined by astronomical methods, and properly marked on stones, and made authoritative by proper legal enactment, would serve as a standard for all time. Then if two surveyors should disagree, it would only be necessary for them to set their instruments on this line placing the sights north and south, and they would find that the two instruments must be set to slightly different variations in order to run a true north and south line. If a surveyor should find that he could not retrace one of his own lines run the previous year, he would find by setting his instrument on the standard line, that owing to a change in the position of the magnetic axis of his needle, he must adjust to a slightly different variation. We should then learn in a short time what the annual change in the variation is at each county in the State and should no longer be obliged to *estimate* this change.

It is certain that all this will be finally done in Missouri, as it has already been done in older States. The only question is, how long will it take the people of Missouri to learn that it will *pay* them to make use of what is well known, and has been practically serviceable in Ohio. It is only necessary for the Legislature to authorize the county courts to employ some competent person to establish such a meridian. There are certainly many persons in the State who are capable of doing such work, and the expense involved is a mere trifle compared with the great benefits to be attained.

The writer desires to say in conclusion, to any person in the State possessing an engineer's transit, that he will at any time send instructions for the determination of the true meridian, provided that the resulting variation of the needle is communicated to him.

THE ISTHMIAN SHIP RAILWAY.

Captain James B. Eads returned to St. Louis on the 9th ult, after a prolonged visit to Europe on business connected with his well known scheme for building a ship railway across the Isthmus of Tehuantepec. From his statements

in an interview with a reporter of a city paper we cull the following items of interest:

"I visited Europe to look into the question and cost of construction of railroads for the purposes of taking ships out of water and transferring them to railroads, and the best and most economical systems. I examined very particularly the Anderton Barge Lift, by which the Bridgewater Canal and the river Weaver are put in communication with one another. The surface of the canal is fifty-one feet above the river, and, to avoid the use of locks, a section of the canal about 130 feet long is supported on the ends of long, vertical hydraulic plungers or rams, and lowered, with 250 tons of water in it, to the surface of the river, with a canal-boat in it. At the same time another section of the canal, of the same size, supported in precisely the same manner, is raised up with a canal-boat in it from the river and joined to the canal. The operation is done in three minutes. The machinery has been in operation for six years, without entailing a single cent for repairs, and without an accident occurring during that time. The Government of France had the work examined critically, and has contracted with the builders of it to apply the system upon one of the French canals. Then instead of lifting 250 tons it will lift 1,000. The Belgian Government has also investigated the subject, and has ordered a similar lift for one of its canals to raise 1,300 tons. The engineer who designed and constructed the Anderton Barge Lift, has written to me proposing to erect works at each end of the ship railway, on a plan somewhat similar, by which ships of any size may be raised in thirty minutes, forty-six feet high, ready for the journey over the railway. The plan which they propose is now in operation in Bombay, where a weight of 10,000 tons has been lifted in this way. Another similar dock is in operation at Malta and another at the Victoria Docks, London. The work is designed by Edwin Clark, who was Chief Assistant Engineer to the celebrated Robert Stephenson. The method proposed for the Ship Railway does not contemplate raising vessels in pontoons of water as at Anderton. In the Malta and Victoria Docks many vessels have been taken out with full cargoes on board. They are taken entirely out of the water —dry—on an iron platform which is suspended between two rows of hydraulic presses. On the platform a section of the ship railway would be laid to correspond with the railway on shore. When the platform is up the ship car would be run on to it and then the platform would be lowered down into the water sufficiently deep for the ship to float over it. The various supports necessary to sustain her would be moved up automatically in contact with her keel and bottom, and she would then be raised out of water until the rails on the platform would come in connection with the terminus of the ship railway. This being done, the locomotives to haul her would be attached to the car which would then be started across the Isthmus and lowered into the water at the other side by the same means."

Captain Eads took occasion to correct the impression that he designed carrying the vessels over in tanks of water on wheels.

"I never advocated any such method, as it would be useless expense to

e quantities of water without pay, from ocean to ocean. With any ordinary care the danger of straining vessels in transit would not be possible. A substantial road bed is an absolute necessity for the success of the Ship Railway. If we had to build over ground that would not sustain it I should excavate a canal through such part of the route and float the ship through that part of it until the solid ground was reached; but we shall have no such ground as this on our route. If but one ship with a full cargo had ever been taken out on a dry dock without injury it would be proof that others could be taken out in the same manner. I have the names of a score of loaded vessels that have thus been lifted out of dock, and in traveling over the ship railway they could not possibly be subjected to as much vibration and jarring as powerful steamships are by the action of their propellers upon going at full speed."

To the question whether the English engineers had faith in the success of the undertaking he replied:

"Yes; I never have met a civil engineer who questioned the possibility of constructing a railway, locomotives and cars by which loaded ships of any size could be carried across the isthmus. In rare instances, I have met civil engineers who doubted whether the ships themselves would bear such usage. Shipbuilding is a branch of civil engineering, and experienced builders of ships are best qualified to judge of the possibility of such transportation being done without injury to vessels. Many of the very best ship-builders in this country and England have given me their written assurances that any seaworthy ship will bear such transportation on a good railway, if ordinary skill and care can be used in adjusting the supports under her.

"As to the economy of transporting freight, my inquiries in England satisfied me of the absolute truth of what I had always contended upon this point, namely, that transportation by ship railway is unquestionably more economical than by canal. The cost of transportation on the ship railway should be much less than that upon the ordinary railroads, for the same reason that transportation on large vessels, barges, steamboats or ships is much cheapened in proportion as we increase the size of such vessels, for the same reason that transportation by rail can unquestionably be greatly cheapened by increasing the quantities which are moved *en masse*. I have no question whatever in my own mind that a ship railway to carry barges of 1,000 tons capacity can be built and operated much more economically between Chicago and St. Louis than by the construction of a canal to float the same sized barges. They could be loaded in the lake, and transported by rail to the Mississippi, and towed down to New Orleans without re-handling cargoes. It has been offered in evidence before the House of Commons, in England, that coal is transported for one farthing or one-half cent per gross ton per mile on English railways, at a profit to the road and defraying the cost of returning the empty cars. I am satisfied that the actual cost of transporting cargoes on a well built ship railway across the Isthmus, a distance of 125 miles, will not cost more than sixty-two and a half cents per ton from ocean to ocean. This would cover the motive power, repairs and maintenance of every kind, including

wages, supplies, and in fact everything except interest on the capital invested. To-day they are paying from San Francisco to Liverpool, via Cape Horn, $21 per ton for freight. I saw a number of owners of ships engaged in this trade, and was assured by them they could well afford to pay one-third of what they received for crossing the Isthmus with their ships. This would be $7 a ton, more than ten times the actual cost of transporting ships over the railway when it is once completed."

Captain Eads seems certain that Congress at its next session will pass his bill, and gives the following reasons why it should be passed: "1. Because no proposition of such novelty has ever been presented to the people before which has so completely silenced ridicule and won the confidence of thinking people. 2. Because the work is required more imperatively at this time than during any previous period of the world. 3. Because the concession secured by me from Mexico enables me to give to the United States the absolute control of the Isthmus, exclusively in the interest of American commerce. 4. The route lies through Mexican territory, and the railway will tend to develop a greater commercial and social intercourse between the two republics, and immensely promote the material interests of both. 5. It will be almost unanimously supported by the representatives of the Mississippi Valley and the Gulf States, for the reason that it will give to this section of the country, embracing much more than one-half of the total area of the American Republic, direct communication with the enormous commerce of the Pacific Ocean and the Orient, from which they are to-day completely shut out by the Isthmian barrier. It is not generally known that New York is considerably nearer to the Orient by way of Cape Horn than either New Orleans or Galveston. Finally, I am confident that the bill will be passed by Congress because the proposition is a fair one, and I have received the assurance of more Senators and Representatives that they will support the measure, than I ever received before the passage of any one of the jetty bills, although they were passed by immense majorities in every instance."

In regard to

THE CONDITION OF THE JETTIES

At the mouth of the Mississippi River, Captain Eads assured the reporter that, "There has not been an hour nor a minute in the last two years during which there has not been an abundance of width and depth in the jetty channel, not only for the larger steamers visiting New Orleans, but for those visiting New York. It is asserted that a vessel rubbed the bottom while drawing only twenty-three feet. Vessels will rub the bottom if there was fifty feet in the channel, if they get too far to one side or the other of it. I am not required to furnish pilots, and if they do not find a channel it is their own fault. If the vessel alluded to had grounded at the time named, the captain would have found a twenty-six foot channel, more than 200 feet wide, immediately to the eastward of his ship, and through which there existed at the time a central depth of thirty feet. In only a few instances have vessels grounded by getting out of the channel during the last two years. The Pass is not straight, and long steamers, unless great

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care is used by pilots, in ascending are liable to 'take a sheer,' and in such cases ground on one side of the channel before the pilot can prevent it, but in no instance of this kind has there failed to be an abundance of water in the channel, and no interruption whatever has occurred by the grounding of such vessels, to the passage of others in either direction. I tried with all the arguments that I could use to have the Southwest Pass improved instead of the South Pass, because it discharges four times the volume of water, is twice as deep and twice as wide, but the Senate reversed the action of the House in the matter and gave me the little Pass to improve, the Commission of Engineers to whom the matter was referred having declared that the little one was sufficiently large for the present and future purposes of commerce. The Pass itself has from twenty-six to thirty feet of water in it, and the law contemplated no improvement whatever in the Pass for reasons just stated. It is ten miles long. The jetties are at the end of the Pass, extending out into the sea two and a quarter miles, and the law does not require me to maintain any definite sized channel through the Pass at all, but expressly provides that I shall be paid $100,000 per annum for maintaining a channel through the jetties, having a central depth of thirty feet and a channel twenty-six feet deep with a bottom width in no place less than 200 feet. This latter width has been maintained during the last year and a half without interruption, except during four days, when it was diminished to 110 feet in width by the rising of a 'mud lump.' For these four days a proportionate deduction from my compensation was made by the United States, although the contract depth of thirty feet existed at the time through the channel, and the 110 feet of twenty-six-foot water was of ample width to have passed the City of Rome with safety. The channel is measured every week or two by my own engineers, and is carefully surveyed and measured by the United States engineers whenever they think it can be found deficient. Their surveys are made without regard to any fixed time, and parts of the channel suspected of deficiency are measured by them two or three times a week. In addition to this absolute testimony to the falsity of these reports, intelligent people recognize the fact that within two years New Orleans has risen from a fourth class exporting port to a second-class one, and no one can cite the instance of a single vessel that has been detained a single minute by grounding in the channel, whether in the Pass or the Jetties.

"I have said and done all I can to secure the improvement of the river. Its commerce has now a chaice of all the Atlantic markets of the world through the Jetties and Straits of Florida, and I intend to devote my utmost energies to securing for it a choice of the markets of the Pacific by giving the Mississippi River an outlet across the Isthmus of Tehuantepec."

Captain Eads will remain in St. Louis a short time when he will leave for New Orleans to take the "City of Merida" for Mexico. He will cross the Isthmus to examine the lines surveyed by his engineer during the past ten months, and will visit Vera Cruz for the purpose of submitting plans for harbor improvements at that port.

ARCHÆOLOGY.

PREHISTORIC MAN IN LAFAYETTE COUNTY, MISSOURI.

BY PROFESSOR H. A. REID.*

The relics of the mound-building race, found in this county, are not so numerous nor so rare as the remains of the same people which have been found in a few other counties; yet they are enough to show that the site of the city of Lexington and its vicinity was occupied by the ancient people, probably for a long period of time and in considerable numbers.

MOUNDS.—Mr. George Wilson, of the Lafayette county bank, informed me that when he was a small boy there were three mounds on a part of the premises now owned by the Elizabeth Aull Female Seminary; two of them were dug away when the foundation was made for the house now occupied by President J. A. Quarles of that institution, but nothing was found except a few decayed bones, some beads, and small trinkets of no special significance. One mound still remains in Prof. Quarles' back yard, which I examined. It is a low, weatherworn knoll on the brow of the bluff overlooking the Missouri River, and so nearly obliterated that it would scarcely be noticed except by persons who had some knowledge of or special interest in this class of remains.

In company with Mr. Charles Teubner, of Lexington, I visited two mounds on T. R. E. Harvey's land, about two miles northeast of the city. They were the usual form of oblong knolls, perhaps twenty rods apart, on the brow of the bluff, and commanding a magnificent view of the river and country beyond. One of these mounds is still six feet high and has a recent grave on top of it, but neither of them have ever been opened. At another time, in company with Mr. Teubner and Dr. Sanford Smith, I visited a mound two or three miles southwest of the city on the Odell place. This mound was about seven feet high, and old Mr. George Odell had dug into it from top to bottom some twenty or twenty-five years ago, but found nothing except some crumbly human bones, and that a layer of flat stones had been arranged on the original surface of the ground before the mound was built. These stones we detected *in situ* at one side of the mound where the earth had been washed away by many rains. The stones had been brought from a shelving ledge perhaps a hundred rods distant and part way down the bluffs; but the mound was on the highest point of land in that vicinity, and from its top we could see objects which Dr. Smith, who has lived there about forty years, assured me were twenty-five miles distant up the river, and it is probable that this mound had been used as a signal tower.

* I have been engaged for about four months in preparing a history of Lafayette county for the Missouri Historical Company; and this article is prepared from advance sheets of that forthcoming work.

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The foregoing were the only mounds I visited, but a total of fourteen were reported in the county. W. H. Chiles, Esq., reported a group of five mounds about eight miles south of Lexington, on Brush creek where the old Lexington and Warrensburg road used to cross the stream, and that none of them had ever been opened. Ethan Allen, Esq., of the *Lexington Intelligencer*, reported one mound on Wm. T. Hays' place and two on Dr. Wilmot's place, from three to four miles east of Lexington, neither of which had ever been opened.

MOUND-BUILDER'S ART.—I learned of a place about a mile east of Lexington city that was called "Indian Hill" by some of the "knowing boys" of the city, who had often gone there to pick up flint arrow-heads. Two bright lads of this class went with me to the place one day, and after a careful inspection at that time and several subsequent visits, I was persuaded that it had been the site of a prehistoric village. I say "prehistoric" because there is no evidence found in any reports by the earliest French or Spanish prospectors in this region that the Indians had any village at this point. I learned that many pocketfuls of arrow-heads had been found here (within a space of five or six acres), and three or four stone axes also, but no one seemed to have ever noticed the pottery or thought of its having any special significance. I gathered fragments of pottery from time to time until I had specimens bearing over thirty different sorts of ornamentation. In addition to these I gathered three or four quarts of flint chips, broken arrow-heads, and some whole ones, besides other curious specimens. But the most rare and interesting "find" was the lower part of a tiny copper axe, showing the whole blade of the instrument, and remarkably well shaped. It is one and three-eighths of an inch across from corner to corner of the blade; then the width narrows a little up toward the handle place, and it is a little flatter on one side than the other, and three-sixteenths of an inch thick. The fragment is broken off below the handle place, and the break is five-eighths of an inch up from the edge on one side and fifteen-sixteenths up on the other side. My first impression was that it had been hammered into shape from a piece of pure copper ore, such as I have seen in great masses from the Lake Superior copper mines; but finally concluded that it had been molded in a crude mold such as "us boys" used to whittle out in pieces of shale (mistakenly called "soapstone"), and then pour in melted lead. In Col. Switzler's History of Missouri there are some very excellent chapters on "Prehistoric Man," written by A. J. Conant, of the St. Louis Academy of Sciences, and on page 108 he says:

"It has been stated, and often repeated, that they [the mound-builder folk] had no knowledge of smelting or casting metals, yet the recent discoveries in Wisconsin of *implements of copper cast in molds*, as well as the *molds themselves*, of various patterns, and wrought with much skill—prove that the age of metallurgical arts had dawned in that region, at least."

It is a well established fact in archæology that the prehistoric peoples of America had a very wide range of intercommunication and rude barter; and I think it altogether probable that the fragment of a copper ax which I found in con-

nection with flint chips, arrow-heads, ancient pottery, etc., on the site of an ancient Mound-builder village at Lexington, Missouri, was molded by the ancient copper-workers referred to by Mr. Conant, as above quoted. It was too small for any practical use as an axe or weapon, but the rich shiny quality of polished copper would render it as precious a metal with a primitive and rude people as gold is with our modern nations; and hence it is presumed that this specimen was probably an amulet or else the token of authority owned by some barbaric chief.

Another curious relic which I found there was a piece of brown hematite, wrought or flaked off into the shape of a box turtle, one and one-half inches long, one and three-sixteenth inches wide and one-half inch deep from top of the rounded back to the flat bottom part. It is so manifestly flaked into its present shape that there cannot be any mistake about it; and the bottom or flat side is worn very smooth. My conclusion is that it was a game piece of some sort, to be moved around on a marked robe, or on the ground, something after the fashion of checkers, morris men, etc., either for pastime or gambling purposes. There was found, a mile or more from this ancient village site, and sent to me by Col. John Reid, of Lexington, a ball of flinty hornstone about as large as a medium-sized Osage orange, and I think from its appearance of wornness on one side that it was made by the stonefolk and used as a muller or pestle for triturating their parched corn, roasted acorns, etc., and probably also for pulverizing red, yellow, and other colors of ochre to mix their paints for war parties, dances, feast days and grand occasions. Mr. Jackson Cox, of Sniabar township, plowed up in his field a very fine specimen of ancient stone pipe and sent it to me. It is of ovoid form, with a groove and creases worked very neatly around each way from the stem hole; its material is a heavy, compact dirty-blue variety of pipestone; the bowl cavity is relatively small, and that and the stem-hole are both of a uniform sharp taper, as if the maker did not know how to make a hole as large at bottom as at top, and the groove, therefore, may have been intended to hold in place a thong by which the pipe stem was held into its socket.

THE TEUBNER COLLECTION.—Mr. Charles Teubner, of Lexington, Missouri, has a collection of mound-builder relics numbering over 2,300 specimens in flint, such as arrow-heads, spear-heads, javelins, daggers, bird-darts, drills, reamers, fish-spears, shovels, hoes, scrapers, knives or lances, game pieces, etc., etc. The materials represented in these specimens are flint, hornstone, agate, chert, chalcedony, hematite, slate, milky quartz, and vitreous or glassy quartz crystal. Among these are over one hundred specimens known as bird-darts, being perfectly wrought and finished arrow-heads, less than an inch long—some very tiny ones, only half an inch or five-eighths in length. These are supposed to have been designed especially for shooting small birds of brilliant plumage, the feathers of which were used by some tribes in making a rich and gaudy kind of cloth, which exceeded in princely gorgeousness and splendor the costliest silks and velvets known to European courts. It was made in about the same way that some good housewives nowadays make most elegant rugs, by knitting common store twine and looping a small shred of silk fabric into each stitch, and when fin-

ished shearing the shred ends all to an even length. However, the feathers would have to be worked in so as to make their plume ends come right, without trimming. Garments of this sort of fabric were found by the Spanish invaders in Peru, Mexico, and as far north as an Aztec village of sun-worshippers where the city of Vicksburg now stands.

About nine hundred specimens of Mr. Teubner's collection are arranged on black oil-cloths so as to form five life-size figures, as follows: No. 1, Indian with battle ax, raised in the act of striking a savage blow. This figure or chart is composed of 181 flint arrow and spear-heads, so arranged as to depict the Indian physiognomy, costume and action with great vigor and lifelikeness. No. 2, Indian with drawn bow and arrow, full life-size, and the Indian's redness of face, even, is artistically represented by using red or coppery tinged flints, for that part. This design is composed of 192 pieces. No. 3, A deer running. This is a companion-piece to No. 2, and contains 93 flints, beside a small pair of deer horns. No. 4, Indian smoking the peace pipe. This chart contains 147 flint specimens. No. 5, Indian squaw and papoose. This is the masterpiece of all; it contains 296 flints, so exquisitely arranged that the woman's moccasins, frilled skirt, flowing hair, and nursing breast are perfectly represented; the child's figure is very perfect, even every finger and toe being plainly seen; and by a marvelously skillful use of the different shapes and colors of the arrow-heads, an expression of glee or laughter shows in the face of both mother and child as she stands playfully tossing the little sucker as high as she can reach.

The specimens of which these figures are composed were all collected in Gasconade and Franklin counties, Missouri, during the years 1873–74–75, by George H. King, Esq., now of Kansas City, but who was then school commissioner of Gasconade county. He made the charts, and had them displayed in the Missouri building at the Centennial exhibition at Philadelphia, 1876. Mr. Teubner afterward bought them and added them to his Lexington collection. He has specimens from Lafayette, Gasconade, Franklin, Pettis, Montgomery, Boone, Warren and Jackson counties in Missouri, and also from the States of Kentucky, Ohio, Indiana, Virginia, Maryland and New York. Besides the flint specimens, there are grooved stone hammers and axes weighing from twelve ounces to five pounds. Two of these are of brown hematite (iron ore), almost as heavy and hard as real iron. There are also stone bark peelers, skin-dressers, corn-pestles, paint cups, game discs, pipes and various other tools, trinkets, amulets, etc. I suppose there are two or three other larger private collections in the United States than this, but I doubt if there is another one which contains such a great variety of the rarest forms in ancient flint work, and so many exquisitely finished and perfect specimens. He has samples in every material I have ever seen used for arrow-heads except obsidian or volcanic glass. Mr. Teubner has been over twenty years making his collection, and still pursues it with unabated zeal and perseverance, aiming ultimately to give the city of Lexington and State of Missouri the honor of having both the largest and best collection of the kind in the United States, outside of the Smithsonian Institution at Washington.

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THE ART OF FOUNDING IN BRASS, COPPER AND BRONZE.*

BY EDWARD TUCK.

The origin of the art of founding can only be a matter of speculation, extending as it does so far back in the past history of the race, a history to a very large extent wrapped in obscurity and mystery. But the marvelous results of the various operations and the immense importance they have to mankind, have caused many in ancient times to assert that the art was communicated to man by the gods. Some, and with a larger share of truth, consider that man, finding by accident that certain minerals by the force of fire yielded a metal, repeated the experiment on other minerals, finding out other metals, and thus ultimately all the differing forms in which they exist in the earth. As late as 1762 a large mass of mixed metals, composed of copper, iron, tin, silver, was melted out of the earth during the conflagration of a wood accidentally set on fire, and various ancient historians speak of metals having been melted out of the earth during the burning of woods in the Alps and Pyrenees.

Copper is occasionally found in nature in a metallic state so pure as to be used for manufacturing purposes, either for making articles of copper or alloys. There are examples of this in the mines of Lake Superior in North America, where large masses of copper have been found weighing several tons. It may, therefore, be considered quite possible that quantities of copper were found in the earth in the olden time, so that the ancients could possess the metal without the necessity of smelting. But, however, this fact must be stated, that where a mass of copper is found embedded in the earth at any depth it would require a greater amount of skill and mechanical knowledge to get this into working operations than to smelt the ore. Such a mass could not be broken up like stone, but must be cut, and therefore would require tools of particular hardness, and other mechanical appliances, to obtain which requires a greater and more refined knowledge of metallurgy than smelting copper from the ore.

But whatever or wherever may have been the origin of the art, it is quite certain that it originated at the very earliest period of man's history and has gone down with him along the stream of time to this age. It has had, as all arts have had in varying ages and nations, its rise and decline, which make the investigation of its history a somewhat difficult task. Still, by the aid of researches which have been made amongst the ruins and relics of past buried ages, we have been able to gather together some facts which help us to form something like a history of the art, very imperfect in many points, yet enabling us to form some idea of the methods of working and the means by which certain results which are matters of wonder to us even now were accomplished.

We have, it is true, in these modern days advanced far, very far, in the metallic arts; but in the great facts and principles we are no farther than the men of

* A summary of the second prize essay of the Worshipful Company of Founders, 1880-81.

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the past. In the matter of tools and means of production we have advanced so that we may produce in one week as much as they did in one year. But still the fact remains, *they accomplished the work*, and in the especial matter of bronze we have not yet reached the height of perfection to which certainly they attained.

Pliny and other ancient writers are very far from being correct in their descriptions of the manufacturing processes; and even the translators of their works have added to the confusion, either through ignorance, or on account of the poverty of the original language in technicalities, as we find brass in one place, white copper in another, copper in a third, all referred to indiscriminately, whether referring to pure copper, the alloys whitened by the addition of lead, tin, or any other process; although Pliny certainly does describe more correctly the casting of bronze, for he says: "The mass of copper was brought to a liquid state, then was thrown into a third part of old bronze and 12½ per cent. of plumbum argentarum," *i. e.*, tin and lead in equal parts. We shall, therefore, trace the history of the art of founding, so far as we have been able to gather it from the past history of ancient times and the researches into and about the buried cities, and trace its course down through the ages to the present time.

The oldest reference we find in Holy Writ is in the Book of Job (the oldest work extant), Ch. xxviii. 2, "Brass is molten out of the stone." In the original Hebrew the word is *Nechosheth*, meaning literally copper. This must be so, as brass, being an alloy and not a pure metal, is not smelted, or, as it is put here, "molten out of the rock." The next reference is in Genesis iv. 22; "Tubal Cain, an instructor of every artificer in brass and iron." The same word *Nechosheth*, is used here, literally copper; but seeing that copper is a difficult metal to work, we believe that the alloy of copper bronze is really meant. We incline to this belief because there is only one other reference to copper in the Old Testament (Ezra viii. 27): "Two vessels of fine copper, precious as gold." And here the same word is used. We find that tin, which mixed with copper forms bronze, certainly was known to the ancient Israelites, as in connection with the spoil taken from the people of Midian 1452 B. C. (Num. xxxi. 22) they are commanded by Moses to purify the silver, brass, iron, tin, and lead by passing it through the fire. (Moses appears here to mention all the metals then known.) Whether the tin came from India or not there is no sufficient evidence to prove, but it appears certain that the productions of that land were known in the earliest times, by "the gold of Ophir" being mentioned in Job.

If the Phœnician ships did not actually sail to India, its productions arrived partly by land through Arabia, partly through more distant marts established midway from India by the merchants of those and later times; and we have evidence of their having arrived in Egypt at the early period of Joseph's having been taken there, by the spices which the Ishmaelite caravans were carrying to that land. And the amethyst and other objects discovered at Thebes, of the time of the third Thothmes and succeeding Pharaohs, and which must have been brought to Egypt, argue very strongly that the intercourse was constantly kept up. Bronze,

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composed of tin and copper, was found in Egypt of the time of the sixth dynasty, 2,000 years B. C.

The first work of art of which we have any details in Holy Writ is the Ark made by Moses, and generally called "the Ark of the Covenant." It was also the first work performed by the Israelites as a nation. A large portion of the works in connection with this are of pure gold beaten out with the hammer; and although these show mechanical skill of a very high order, they are outside the scope of our paper.

We read (Exodus xxxviii. 8), "And he (Moses) made the laver of brass, and the foot of it of brass, of the looking-glasses of the women," etc. The word translated "foot" should be, as given in the margin, "cover." This laver, or large basin, in which the priests were to wash, must have been a large work to cast, and it shows a complete and accurate knowledge of the different sorts of bronze for different purposes that the cover should be made of the mirrors of the women, brought by them out of Egypt, and which, containing about one-third more of tin in the alloy, constituted speculum metal. So that the cover of this huge washing basin formed, when raised, a mirror in which the priests could examine themselves before approaching the altar. There were besides this many other articles used in the erection of "the Ark of the Covenant" made of bronze. Dean Prideau gives as the weight of bronze used, 10,277 pounds troy weight. The entire weight of the articles made in the three metals, gold, silver, and brass or bronze, was 14 tons 2 cwt. No one can read over the narrative of that undertaking, viewed independently of the adverse circumstances of the Israelites, wanderers in the wilderness, without perceiving that many amongst them possessed great skill; some had most probably been amongst the highest class artisans of Egypt. The ease with which these elaborate works connected with the Ark, as well as the Golden Calf and the Brazen or Bronze Serpent, were produced, show that they had not been employed solely in the labor of brickmaking whilst in Egypt, but that in all probability many of them were working men in the Egyptian foundries and other public works in which metal articles were manufactured.

Bronze being a mixture of copper and tin in variable proportions, every variation produces a bronze of different quality, more or less suitable for different purposes. One quality will have great hardness and very be brittle—another hard and flexible; one gives a bright reflecting surface when polished, suitable for mirrors —another is famous for its sonorous quality, and is therefore suitable for bells, gongs, etc. Before these properties and differing qualities could have been found out some length of time must have intervened, as such knowledge of practical facts could not have been obtained until society had gained a considerable advancement in the arts. We are able to show by analyses that have been made of the bronze of the Egyptians and other ancient nations, that it was of such varied qualities, requiring a great amount of knowledge and practical skill as well as pure materials. Consequently these ancient people must have attained the knowledge before they could procure the varied articles. A chisel found by Wilkinson in an Egyptian quarry gave copper 94.0, tin 5.9, iron 1=100.' A dagger, analyz-

ed by Klaporth, copper 91.6, tin 7.5, lead 0.9=100. Bowl or dish from Nimroud, copper 89.57, tin 10.43=100. Bell analyzed by Dr. Percy, 84.70, tin 14.10. Thus showing where sound is required the amount of tin is increased, where strength is required the amount of tin is decreased. Dr. Percy found also a small casting, in the shape of the fore-leg of a bull, forming the foot of a stand consisting of a ring of iron standing upon three feet of bronze. A section made disclosed a central piece of iron over which the bronze had been cast. The casting was sound and the contact perfect between the iron and the surrounding bronze, and it was quite evident on thorough inspection the bronze had been cast round the iron, and not the iron let into the bronze. The analysis gave copper 88.67, tin 11.33. No perfectly satisfactory conclusion can be arrived at whether the iron was employed because required in the construction or to economize the more costly metal—the bronze required for the ornamental purpose; we are inclined to the former in this case. Sir Henry Layard speaks of the bronze vessels, which he supposes to have been used in the religious ceremonies, as especially deserving of attention, as demonstrating the skill of the Assyrians in their treatment of bronze. One specimen may be particularly noted: "A thin hollow casting in bronze which was attached to the end of one of the arms of the throne. This casting had evidently been chased, and for that purpose must have been filled with some substance, such as pitch, which is used at the present time, as in the interior was some black compound which was like pitch and left an earthy residuum, and was probably a mixture of asphaltum and earth." It is quite evident that the Egyptians at the time the Children of Israel were in captivity amongst them, and even long before that period, were very skillful in working the metals, especially bronze. We have no exact idea of the form of the furnaces or materials used in their construction, but that they had great facility in constructing such furnaces is evident from the short time taken by Aaron to cast the calf or bull when in the wilderness. So we may presume that the Hebrews had been many of them laborers with the skilled artificers of Egypt, and, when leaving, had taken away their tools and the knowledge of the art in which they had worked with them. But whether the same or similar means were adopted for overcoming the difficulties of founding as in the present day, this fact remains, the difficulties were overcome, and the metals then known were used in abundance and as pure as we now have them.

Wilkinson, in "Ancient Egypt," gives the figure of a smelting or melting operation from one of the ancient monuments. The furnace seems only a heap of fire on the surface of the earth, and the bellows are two large bags filled with air, upon which a man is standing with a foot on each bag, the aperture of the bag being connected with a pipe leading into the fire. While the man appears to be putting all his weight on one bag to compress the air out into the fire, he is lifting up his other foot, and at the same time the upper fold of the other bag by a string in his hand, by which the bag is again being filled with air. This apparatus is no doubt both simple and rude, and if it refers to the ordinary metallurgical operations performed by the nation, one could hardly suppose that cast-

ings of any great size could be obtained except with much difficulty. Still it shows that the methods adopted for getting an intense heat were similar to ours, viz: by bellows or blowing.

Ordinary bellows are said to have been invented by Anacharsis the Scythian, but that must have been long subsequent to this period. Very little can be discovered to illustrate the means employed in metallurgical operations from the objects found in the excavated tombs, or from the paintings beyond the use of the blowpipe and the forceps, and the concentration of heat by raising cheeks of metal round three sides of the fire in which the crucibles were placed. Homer notices "that the Egyptians and other Asian workmen excel in the manufacture of arms, rich vases, and other objects inlaid and ornamented with metal." Herodotus and Helanius both say, "the Egyptians drank out of bronze goblets" We find that statues, musical instruments, implements of all kinds, adzes, axes and chisels, articles of furniture, bedsteads and footstools, and many other domestic utensils were all made of bronze. Also biers, on which bodies were placed after death. The Egyptian vases are numerous and to be noticed for beauty of form and the design ornamenting them, as well as for the superior quality of the material. Those used in the service of the temples were especially beautiful. One found by Mr. Salt had an elastic spring to the cover, and the nicety with which it is fitted exhibits evidence of great skill in the workmanship.

The sistrum was *par excellence*, the sacred musical instrument, and was usually of bronze or brass, sometimes inlaid with silver. One now in the British Museum is entirely of bronze, having a hollow handle closed by a movable cover of the same metal. The cymbals, or clappers, which when struck together emitted a sharp metallic sound, were of mixed metal, probably copper and silver, and in shape much resembling those of modern times.

It is not known at what times the ancient Egyptians began to cast statues and other objects in bronze, or how long the use of beaten copper preceded the art of casting. Many bronzes, however, have been found of a very early period. A cylinder with the name of Papi, of the sixth dynasty, has every appearance of being cast, and other bronze implements of the same age bear still stronger evidence of having come from a mould, all of which date more than 2,000 years before our era. The Egyptians, too, appear to have possessed the secret of giving to their cast bronze blades a certain degree of elasticity, as in the dagger now in the Berlin Museum, which probably depends for this property on the just proportions of the peculiar alloys used in its manufacture, as well as on its mode of having been hammered. Another remarkable feature in this bronze is the resistance it has offered to the effect of the atmosphere, continuing smooth and bright though buried for ages, and since exposed to the damp of the European climate. It may be said that the Egyptians had not any mines of tin wherewith to produce the bronze alloy. It is true that the mountainous districts of Egypt, between the Nile and the Red Sea, produced iron and copper only. Copper was also found in Arabia Petræa, which district was known to them, and even now amongst the heaps of refuse there we come upon the tubes used in the smelting apparatus.

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Mines are mentioned by Agartharchidas, a Greek writer of the age of Ptolemy Philometer, and he gives a curious picture of the mode of working these mines, which were probably near the coast now called Jebeel Allaka. For additional evidence we learn from Mak rizi, an Arab writer, that this region produced silver and copper; and tradition names both Egyptian Pharaohs and Greek Ptolemies as workers of the mines. But, as we have already shown, they traded with India, and at this time, as well as from Spain, tin could be procured there.

The Phœnicians, to whom the art of navigation is so much indebted, and who carried the spirit of adventure beyond all the ancient nations, obtained tin from both India and Spain long before they visited the more distant shores of Britian, and discovered how rich were the mines of that metal there. It was worth their while to undertake a long and risky journey at sea, with possibly no other method of ascertaining their course than the stars, from the high price they were able to obtain for this commodity in Egypt and other countries where, as at Sidon, the different branches of metallurgy were carried on to great perfection. Strabo, Diodorus, Pliny, and other writers, mention certain islands discovered by the Phœnicians, which, from the quantity of tin they produced, they called Cassoterides, though the locality is not given, for Strabo says, "The secret of the discovery was carefully concealed;" and it is said that a Phœnician trader ran his vessel on a shoal and was shipwrecked, when pursued, rather than disclose his country's secret; for which he was rewarded from the public treasury. Strabo and Pliny both mention that tin was found in Gallicia and Lusitania, and further say that in consequence these countries became a rich mine of wealth to the Phœnicians.

Herodotus describes the doors of the Temple of Belus, at Babylon, as made of metal, probably bronze. The people would be more induced to attempt such work as bronze doors of their temples and public buildings in consequence of the scarcity of good timber suitable for the purpose in the land.

[*To be Continued*]

THE AMERICAN HORSE.

BY E. L. BERTHOUD, GOLDEN, COLORADO.

It is generally understood, and the fact (if it is a fact) has been almost universally accepted that the Horse was unknown in the New World previous to the advent of Spaniards in North and South America. Late discoveries and investigations extending from Behring's Straits to Patagonia, have revealed the fact (see Prof. Marsh in Encyclopædia), that in North and South America we have twelve fossil species of the genus equus, and thirty more species allied to them.

Prof. Marsh has proved conclusively the filiation of equine ancestry from the Quatenary to the Eocene, and the progressive evolution of the Horse from a many-toed ancestry. His deductions have been accepted as conclusive and

as an irrefutable proof of the evolution theory founded upon the close study of ancient fossil remains. Prof. Marsh has named a species of fossil horse found in North America, which is closely allied to the present living animal, *equus fraternus*—a brotherly horse, thus indicating its close resemblance to our useful assistant and companion.

Having had occasion to send to Paris to purchase some rare maps of the 15th and 16th centuries, I received among them the map of Sebastian Cabot, "Piloto Mayer" of Charles the Fifth, King of Spain. This map, drawn in a circular projection by Cabot himself, on which he has delineated his own and the discoveries of John Cabot, is of singular value as representing the true state of geography and discovery in the early portion of the 16th century, and was drawn up prior to the year 1546–47. Sebastian Cabot having left for England to take service there in 1547, this map was drawn by him while he was in the Spanish service previous to that date.

Now it is an incontestible fact that Cabot went in 1527 to the east coast of South America on an exploring voyage, that he discovered the rivers LaPlata and Parana, and explored them some distance inland, returning to Spain in 1530.

Upon examining that map I find that the Rio LaPlata was explored up to the 25th parallel of North Latitude, and Spanish names given to its branches and all prominent points; and in addition he has marked on the map pictures of the natives, prominent animals and some trees, and that at the head of the LaPlata with the Puma and Parrot, or perhaps the Condor, he has given the horse as apparently a quadruped that existed then in those vast plains of the *Gran Chaco*, where to-day they roam in countless herds. It may be claimed that this is not proof of their native origin, but we claim that it is a fair presumption, for neither Spaniards in Peru, nor other parts of America, or even Portugese, had been long enough in South America for the few Spanish horses introduced to have roamed wild from Peru to the head of the Paraguay and Parana Rivers and increased in numbers sufficiently to have attracted the attention of the Spanish explorers. The period was too short, and the distance too great from the Spanish possessions in Peru across the vast forests of the Andes, for such a rapid increase. We can reconcile this discrepancy only by believing that the paternity of the vast herds of the Argentine Republic, and of Paraguay, was a native breed of American horses; mixing afterward with the Spanish breed introduced by the conquerors. Not twenty years had passed between the discovery of Peru and the discovery of the Rio LaPlata.

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GEOLOGY.

MIOCENE FAUNA OF OREGON.

BY CHARLES H. STERNBERG.

I propose in this short paper to give a list of the species of mammals and and turtles collected by my party on the John Day River, and on Bridge creek, of eastern Oregon, during the seasons of 1879 and 1880. I copy Prof. Cope's list published in the bulletin of the U. S. Survey, Vol. 5 No. 1, with some of his remarks on new species. These beds are equal to the White River beds of Nebraska. I have thought this paper might make my article in the January REVIEW more intelligible. For descriptions of species see Palæontological Bulletin, No. 30, *American Naturalist*, December, 1878, and Bulletin above quoted where they are described in detail, by the able paleontologist, Prof. E. D. Cope, of Philadelphia. All these specimens are in his possession.

WHITE RIVER FAUNA.*

TESTUDINATA.—Stylemys Oregonensis, Leidy.

RODENTIA.—Steneofiber gradatus, Cope.
Steneofiber Nebrascensis, Leidy.
Meniscomys hippodus, Cope.
M. multiplicatus, Cope.
Eutoptychus cavifrons, Cope.
E. planifrons, Cope.
E. crassiramis, Cope.
Pleurolicus sulcifrons, Cope.
Palæolagus Haydeni, Leidy.

CARNIVORA.—Hoplophoneus brachyops, Cope.
Machærodus strigidens, Cope.
Enhydrocyon stenocephalus, Cope.

In this new genus and species we observe a nearly complete cranium belonging to the typical species, the shortness of the facial part of the skull as compared with the length of the cerebral, and also the constriction of the skull back of the orbits. The zygomatic arches are robust and expanded, and the sagital crest is high. The auditory bullæ are inflated and thin-walled. The length of the skull is about that of the coyote, but it is more robust in all its proportions except the postorbital constriction.

Discovered by Charles H. Sternberg in the Oregon White River beds of the John Day River region.

* Prof. E. D. Cope, Bulletin U. S. Survey, No. 10.

Enhydrocyon basilatus, Cope; sp. nov.

"This species was probably of the dimensions of the grey wolf."

Temnocyon altigenis, Cope.
Canis Hartshornianus, Cope.
Canis Geismarianus, Cope.
Canis Curpigerus, Cope.
Canis Lippincottianus, Cope.
Canis Gregarius, Cope.

PERISSODACTYLA.—Dæodon Shoshonensis, Cope.
Aceratherium pacificum, Leidy.
Anchitherium equiceps, Cope.
A. brachylophum, Cope.
A. longicriste, Cope.

ARTIODACTYLA.—Elotherium imperator, Leidy.
Palæochocrus Condoni, Marsh.
P. pristinus, Leidy.
P. socialis, Marsh.
Merycopater Guyotianus, Cope.
Eucrotaphus superbus, Leidy.
E. occidentalis, Marsh.
Merycochocrus Leidyi, Bettany.
M. temporalis, Bettany.
Poëbrotherium Sternbergii, Cope, sp. nov.

"This ruminant is represented by a considerable part of the skeleton, with both mandibular rami supporting the teeth of one individual. The third and fourth metacarpals are not coössified and the second and fifth are not distinguishable." This is likely an ancestor of the Llama or Camel.

Boöchocrus humerosus: genus and species new.

"The species on which this genus is founded is represented by a part of the skeleton which is unfortunately not accompanied by cranial bones or teeth. The great tuberosity of the humerus is produced beyond the head, and does not close around the bicipital groove." It was about the size of the Indian Rhinoceros; discovered by C. H. Sternberg.

Leptomeryx Evansi, Leidy.
Hypertragulus calcaratus, Cope.

Prof. Cope places these last two genera in the new family he calls the *Hypertragulidæ*. It connects the *Tragulidæ* with the more typical *Ruminantia*.

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DIATOMS.

HENRY G. HANKS, STATE MINERALOGIST, CALIFORNIA.

A diatom is generally admitted to be a single celled plant, bearing a singular relation to the animal and even to the mineral kingdom, being considered by some to belong partly to the latter, and regarded as a vegetable crystal, differing only from minerals in having the power of locomotion, and of multiplying by separation. Kutzing says: "In comparing the arguments which indicate the vegetable nature of the diatomaceæ with those which favour their animal nature, we are, of necessity, led to the latter opinion."

In connection with the idea that the diatoms pertain somewhat to the mineral as well as the animal kingdom, it is a curious fact that silica deposited from fluoride of silicon, if crushed between plates of glass and examined microscopically, with a medium power, markings may be seen on the outer surfaces of the vesicles which resemble those of the diatoms, especially pleurosigma and coscinodiscus. It is also remarkable that Dr. James Blake collected fifty species of living diatoms from a hot spring in Pueblo Valley, Nevada, the temperature of which was 163° Fahr. Flint probably originates from diatoms, as does also the silica in certain rocks.

The name diatom is derived from a Greek word signifying being cut in two. Diatoms resemble the desmids, but differ in having an outer skeleton, or frustule, of silica. The frustule of a diatom is a silicious box, always in two parts, one slipping over the other like a pill box or with edges apposed. The thickness of a single diatom is, roughly, the sixth that of a human hair, and its weight is estimated at the 187-1,000,000th part of a grain. Some varieties attach themselves to other bodies, as the algæ, while others swim in the water free. The study of the diatomaceæ, aside from their scientific interest, is very fascinating. Their extreme and varied beauty is a source of constant pleasure to the microscopist, and the question is often asked, Why is so much beauty veiled from human sight?

The beauty of the diatoms consists in their color, their general form, and sculpture, or natural marking, which characterize nearly all of them. These delicate markings are seen under the microscope to be processes, knobs, bosses, concavities, ribs, groovings, and lines, so minute that the highest powers made by the most skillful opticians are required to see them at all; even then they can only be seen when the apparatus is manipulated by the most skillful operators. The lines of certain diatoms have been measured, and are used to test the magnifying and penetrating powers of object glasses. A slide called a test plate has been prepared on which twenty well known species are mounted, commencing with one on which the lines are comparatively coarse, and ending with one—*Amphipleura pellucida*—which has 130,000 lines to the linear inch. For the convenience of study typical diatoms are mounted on a single glass slide, so arranged that reference can be made to a printed catalogue for the names, while in some cases the names of the species are microphotographed on the slide.

The diatoms are placed on the plate by the aid of an ingenious device called a mechanical finger, by means of which the shells can be picked up singly and given the desired position. *Moller's Typenplatte No. 1* has twenty-four lines in each of four groups, comprising about 500 individuals of 395 distinct species and 17 genera. The cost, with printed catalogue, is forty dollars.

Some microscopists are so fond of the study of these minute forms that they scarcely do any other work than to observe, collect, classify, and describe them.

When it is stated that the names of more than 4,000 distinct species of diatoms are given in a catalogue published by Frederic Habirshaw, of New York, each of which has some feature by which it may be distinguished, that this vast kingdom, so to speak, is invisible to the human eye, or nearly so, that when highly magnified many of the species are extremely beautiful, and all of them interesting, it is easy to understand why so much interest is taken in them the wide world over, and why every new discovery is heralded, and calls for samples come from the whole scientific world.

It is an established fact, strange as it may seem, that some of the greatest mountain chains, such as the Andes, and the very soil beneath our feet are chiefly composed of the remains of animalcules, invisible to the eye; that is to say, the matter has been used by animated beings, and returned again to the mineral kingdom, retaining the form which it assumed while a part of their minute bodies. Byron has written with more truth than he probably realized that "The dust we tread upon was once alive," and the remark of Dr. Buckland is often quoted: "The remains of these minute animals have added more to the mass of minerals which compose the exterior crust of the globe than the bones of the elephants, hippopotami, and whales."

In the tertiary age, beds of diatomaceous or infusorial earth were deposited, consisting almost wholly of these microscopic organisms. The extent of some of these deposits is almost incredible, and is regarded as an evidence of the great age of the world. The Bohemian deposit in Europe is fourteen feet thick, and, by the estimation of Ehrenberg, contains 40,000,000,000 diatoms to the cubic inch.

Darwin observed in Patagonia, along the coast for hundreds of miles in extent, a bed of tertiary sedimentary formation, 800 feet in thickness, overlaid by a stratum of diatomaceous earth. At Bilin, in Austria, a bed of infusorial earth, fourteen feet thick, occurs. One merchant sells annually many hundred tons of it. The *Bergmehl*, or mountain meal, of Lapland and Norway, is from beds thirty feet in thickness. It must be remembered that these deposits extend over many thousands of square miles. Notwithstanding the astonishing fact that vast areas of the earth's surface are built of these minute forms, the true nature of these deposits was not known until 1837, when Ehrenberg published his celebrated work on that subject. The same deposition is taking place at the present time. In certain lakes in the United States and elsewhere, deposits several inches in thickness accumulate, composed wholly of the remains of recent diatoms. When thoroughly dried a chalky powder is obtained, which, under the micro-

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scope, is easily recognized. Similar deposits have been made known by dredging the bottom of the sea. According to Professor Joseph Le Conte, in the deeper parts of Lake Tahoe, which sediments do not reach, the ooze is composed wholly of diatoms or infusorial shells.

Dusty showers of a grayish or red colour are not unfrequent on the Atlantic and Indian Oceans near the coast of Africa. Ehrenberg examined this dust and found it to consist largely of diatoms. He estimated the quantity let fall during a dust shower in the year 1846, near Lyons, at 720,000 pounds, one-eighth of which was diatomaceous, or 90,000 pounds, equal to forty-five tons. Diatomaceous earth may be distinguished from other formations of a similar appearance by its insolubility in acids, extreme lightness, power of absorbing liquids, and property of polishing metals. It is instantly recognized under the microscope in the hands of one who is familiar with its use. Diasomaceous earth has its uses as well as its scientific interest. It is largely consumed as a polishing powder under the name of tripoli, from the locality which first gave it to commerce. It is known in California by the absurd name of electro-silicon, and at the East by a variety of trade names. It is a very convenient source of soluble silica, employed in the manufacture of silicate of soda or potash, also known as soluble glass. The manufacture of this compound is simplicity itself. Carbonate of soda or potash, as the case may be, is dissolved in boiling water to saturation, in a capacious iron kettle, and fresh hydrate of lime added until all the carbonic acid is precipitated and the alkali becomes caustic. Diatomaceous earth in a powdered state is then added as long as silica is dissolved, and the whole covered and allowed to cool. When the insoluble matters have settled the clear liquid is drawn off and evaporated in a clean vessel to the required density.

Diatomaceous earth is also used in the manufacture of porcelian, and it is a constituent of certain cements and of artificial stones. At one time it was claimed to be a fertilizer, but this is thought to be a fallacy, although Ehrenberg states that the fertilizing power of the Nile mud is furnished by fossil infusoria.

Slabs of diatomaceous earth absorb liquids with avidity, and are used in laboratories for drying crystals and filters. This property might be more generally utilized if better known. A convenient contrivance for lighting fires is a lump of diatomaceous earth with a handle of stout iron wire. It is dipped into a vessel of petroleum, placed in the stove or fire place, and lighted with a match. It continues to burn safely for some time.

Bricks that float in water are made of diatomaceous earth mixed with one-twentieth part of clay and well burned. The art of making these floating bricks was well known in the time of Pliny, but was afterward lost. It has recently been discovered. In the Italian department of the Paris Exhibition of 1878, these bricks were exhibited, which attracted considerable attention. Floating bricks, made wholly of California material, may be seen in the State Museum.

Kieselghur, or "flint froth," of the Germans, from a deposit in Hanover, is extensively used in the manufacture of dynamite, giant powder, lithofracteur, and other explosives. Diatomaceous earth absorbs from three to four times its

weight of nitro-glycerine, with the advantage over other absorbents of retaining the nitro-glycerine under greater pressure. Dynamite contains 27 per cent. and lithofracteur 23 per cent. of diatomaceous earth.

Before the kieselghur can be used it is subjected to treatment to remove water, all organic matter, and coarse particles. It is first calcined in a succession of furnaces, crushed between rollers and sifted.

It is claimed that the diatomaceous earths of California are unfit for this purpose, but it is the opinion of the writer that they have not had a fair trial.

Diatomaceous earth is largely used in the manufacture of soap to mechanically increase its detersive power. The Standard Company receive large quantities of it from the southern counties of the State.—*Mining and Scientific Press.*

GEOGRAPHY.

THE VOYAGE OF THE PROTEUS TO LADY FRANKLIN BAY.

LADY FRANKLIN BAY,
ON BOARD THE PROTEUS, AUG. 17TH.

After vexatious delays the Proteus, with its load of hopeful explorers, has reached this point, where it was the purpose of the party, on setting out, to build a house for the winter. The last two weeks have been very eventful, and fortune has wonderfully favored us.

Our progress seemed to be hopelessly cut off on the 6th by the great Northern ice pack, against whose southern face we lay, wholly unable to advance. Up to that point we had been remarkably favored. Only three other ships had ever reached the place where we then were, off Cape Baird, at the southwestern end of the bay. They were the Polaris, Capt. Hall commanding, and the Alert and the Discovery of the English expedition, under Capt. Nares. Unlike us, all three encountered troubles from Melville Bay all the way up. They had to fight ice continually. The Polaris fared better than either of the others, but she had to fall back finally. Until we reached Cape Baird, 81° 35′ north latitude, we met with no obstacles in the way of ice. We met and passed monstrous icebergs, and passed around and through fields of ice floes, pan ice, etc., but of such a nature that it offered little resistance. The icebergs of course, when scattered are of no particular danger, because we can usually keep out of their way. The only time to fear them is in a fog or storm. But in these respects we were favored when icebergs were numerous. To make a long story short, we came through from Disco to that point in the very quickest time that has ever been made, or that we expected to make. We met so little ice—the waters in Smith's Sound and Kennedy's Channel were, in fact, so free of ice—that we were lost in wonder.

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We had really begun to speculate about running our little steam launch right through from Lady Franklin Bay to the North Pole.

Very soon, however, we ceased to think of such an exploit, by reason of the stern reality with which we were brought face to face. We were suddenly confronted with an impassable ice pack. Since we were within only eight miles of this place, on the north shore of the bay, which was our destination, our disappointment can be imagined. It was of course, useless to lament. We had to make the best of it. The pack extended across Robeson channel from shore to shore, and, we thought likely, all the way to the North Pole. It would have been as useless to try to move the world as to force our way through it. At the ship's side the ice was from eighteen to twenty feet thick. Looking across it, it showed one series of hummocks. I traveled about three miles to the north on the pack, and found it not very easy work. All we could do was to wait and take our chances. We lay in one place two days before the 9th, in which time about half a mile of ice broke away, after which we possibly worked ahead, by starting another point, a mile or so. Then the thickness of the pack increased, and it became more and more rough, hard and hummocky. We were, however, in constant hope that enough would break away to enable us to make our camping place and unload the ship before the whole pack moved, though there was grave danger that the pack would start all at once. In that event we expected to have to run before it, and there was no telling then how far south it would drive us. Of course we did not anticipate with pleasure the possibility of being carried back after getting within sight of, and only eight miles distant from, our objective point. We feared that if driven out by the pack we could not get back this season, because it was to be expected that in two or three weeks' time new ice would form of such thickness that the ship could never cut through it, and the pack ice was not likely to run out in that time. Even at that early day new ice formed every night. I cannot describe how tantalizing the impenetrable barrier was to us, and how powerless we were to do anything.

We hoped for the best, however, and, as it turned out, not in vain. We gradually had to retreat before the pack, dodging floes here and there as we went, until we were fully forty miles south of the place where we first encountered it. Then a southwest gale sprang up, which at last drove the ice toward the eastern shore, and left a free passage for us to run in here. Our house is under way, and everything is unloaded from the vessel except the coal—140 tons. When this is done, which will be soon, the ship will leave us, and we must say our parting words for one long year. The ship cannot stay a moment after she is unloaded, as she would, by so doing, run the risk of being caught in the ice for the winter. This letter will probably reach you sooner than those which I sent you from Disco and Upernavik, since they have to go to Denmark by sailing vessel.

And now about the trip before we reached Lady Franklin Bay. We had some stormy weather on the voyage, and there were only four of us who were not seasick—Lieut. Lockwood, three sergeants and myself. The long day seemed a little strange to me at first, but now I am fully accustomed to it. The sun

with us is now as light at midnight as at noon, and it will so remain until about the middle of October, when the long night will fairly begin. This is the only thing I actually dread. Think of 140 days without the sun! But others have gone through the Arctic night and I think we can. But just think for a moment how blessed, how glorious the sun will appear to us when it first again makes its appearance next March!

We were very successful in our hunting, and in this we are ahead of the other expeditions. At Upernavik and Rittenbeck(we stopped at the latter place a day and a half), and at other places on the bay, we killed altogether and brought to the ship nearly 800 birds, ducks, auks (a sort of a duck) and a few geese. The Polaris and the British expedition did not get so many birds during all the time they were here. My party, consisting of four of us, in one day's shooting brought home 304 birds. This was the best day's sport. The most noted place for bird-shooting is what is called "Sanderson's Hope," near Upernavik. We went there in our whale-boat. It is an island of lofty mountains, and the birds congregate there in countless numbers and build their nests in the cliffs. The cliffs are vertical and of great height. The air is filled with birds, and the noise made by their wings was like a violent hurricane of wind, when, in fact, all was calm around us—the sea without a ripple.

We also killed a polar bear. Most unexpectedly to us all, in crossing Melville Bay we came across a bear on an ice floe. Of course all was excitement in a moment. We were at supper, but hastily jumped up, and I found myself in a boat, together with Lieutenant Lockwood and Mr. Clay, a gentleman who is with the expedition, being rowed toward Bruin, and I did not realize that it was quite chilly, and that I was only provided with slippers and without a coat and gloves, until after the bear was dead. Several shots were fired at him from the ship, and he was hit twice, once by myself, in the side, but neither shot stopped his movements. Finally, from the boat I had the honor of sending a ball squarely through his brain. We towed him after us and got him aboard the ship, and our photographer took a picture of him. Before I left home the Remington Rifle Company sent me from New York their last improved rifle, and no doubt will be pleased to learn that it killed the first white bear of our expedition. He was coming directly toward the boat when I shot him, and looked very savage. He was a powerful brute, and would have made short work of any man if he had got near enough.

We stopped here and there on our way up to examine provisions which have been left by different expeditions, and which we can use should it become necessary. We stopped at Littleton Island, and from there I was sent with a party to visit Lifeboat Cave, and the place where the ship Polaris sank. Part of the Polaris' crew wintered there. This was quite historic ground. The wood pertaining to the house had been taken away, not a vestige remaining, probably by the Esquimaux. There were all sorts of odds and ends, an old stove, stove-pipe, iron, copper, lead, pieces of the engine, pulleys, etc., strewn around the

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place. Our photographer was with us, and I had him make a picture of every thing as we found it. This trip I enjoyed very much.

Coming back we were close to several walruses sporting in the water, and finally succeeded in shooting two of them. One of them was coming toward our boat with his mouth open, and very determined and savage-looking. Mr. Clay and myself let him come within twenty feet of us, when we lodged two balls in his head. Mine went into his mouth. He sank at once and this was the last seen of him. This is the objection to shooting walruses in the water.

They sink as soon as dead, and unless they are harpooned there is no way of getting at them. We had no harpoon. The only certain way to get them by shooting would be to catch them on the land or ice, creep up to leeward of them and shoot them in the head. But this can rarely be done, unless the ball strikes the eye, because their heads are solid masses of bones. Mr. Clay killed the other walrus, a young one. I felt sorry for killing the poor things when we found we could not secure them, and shall not shoot any more unless we can be certain of gathering them afterward.

Another party visited Littleton Island, and secured the mail left by the ship Pandora for the English (Capt. Nares') expedition. This will be sent to England by our returning ship. We also visited Cary Island and Ritter Bay, and left some supplies at the latter place. We also visited Cape Hawkes, and examined some supplies left by the English expedition, and took aboard a fine boat left by them for the convenience of polar expeditions.

We have seen many strange animals of the deep. Schools of white whales and numbers of norwhals have made their appearance frequently. Several seals have been seen, but they are very shy. Lieutenant Lockwood and myself killed a monster square-flipper seal, the largest kind, about 300 miles south of here. We spied him from the ship on a cake of ice, and we rowed out to him very quietly. I sent one bullet through his neck and Lockwood one into his body. He rolled off into the water, but we were close to him, and quickly drove a gaff into him and hauled him back upon the cake and then into the boat. He weighed 400 pounds.

Musk oxen and seals are our main dependence for fresh meat, and, with the exception of bears and foxes, not very plentiful, are almost the only living things found so far north. Occasionally a bear or wolf makes its appearance. We have seen a few geese from the ship, and have killed five dovekies, sometimes called sea pigeons, but the auks and ducks have all apparently remained south. We have killed to-day fourteen musk oxen, which will give us fresh meat for three months for everybody.

We have two Esquimaux with us, and they afford a good deal of amusement to everybody. We depend upon them to teach us many things, particularly dog driving. They appear to be jolly, willing, good-natured fellows, and come highly recommended. I had one on the ice and he gave us considerable sport, especially when it came to jumping across the cracks in the ice. His legs were so short that he frequently fell short of the other side, when, of course, there would be a

scramble. Sometimes the poor fellow would not attempt some of our long jumps, and would have to walk a long distance to find a narrower crack. Usually they have along their kyacks to cross such places with, but this time he failed to bring one. The kyack is a singular-looking skin boat. It is sometimes spelled kayack.—*Cor. Globe-Democrat.*

THE HUDSON'S BAY ROUTE.

The Canadians are building their Canada Pacific R. R., running through the dominion from east to west, and in addition to this they have incorporated the Nelson Valley Railway and Transportation Company, whose purpose is to build a road from Churchill harbor, at the western side of Hudson's Bay, southwardly to Lake Winnepeg, on the line of the Canada Pacific, from where still another road is to be built to tap our Northern Pacific at a point near Bismarck. The object of this scheme is apparent. The distance from Churchill harbor to Liverpool is 114 miles nearer than that from New York to Liverpool, while the distance from Winnepeg to Churchill harbor is 1,300 miles shorter than that from Winnepeg to Montreal by way of Chicago. The great grain fields of the northwest, along the line of our Northern Pacific road, and above that in British America, are the objective point of this system of improvements. This vast region is being rapidly settled and is destined to yield a large proportion of the wheat that must go from America to Europe. The trade is worth striving for, and if the Canadians, with the encouragement and help of British capital, can secure it, the advantage will be a great gain to them and a great loss to our northern lines which are looking forward to it as a heritage they are entitled to. Heretofore, Hudson's Bay has been regarded as in the Arctic region, and too far north to be capable of figuring in the trade movement. But the time was when the region along our Northern Pacific was regarded in the same light, and yet this region is now becoming the great grain district of our country. It is not impossible, therefore, that the harbor at the lower point of the Hudson's Bay, may in the near future become an important shipping point from which the whole trade of the Winnepeg and Saskatchewan will take water for Europe.

THE LOST JEANNETTE.

Intelligence from the Rodgers, sent out by the Government to search for the Jeannette in the Arctic regions, has been received. The despatch is dated St. Lawrence Bay, Aug. 18th, and is in substance, that the whaler R. B. Handy reports the Esquimaux at Point Barrow as saying that they saw four white men going toward Mackenzie River this spring, and found where they had made snow huts to live in during the winter. They saw dead men in the huts, and also saw tracks of a sledge, with dogs and footprints of men, supposed to be survivors of the Jeannette. The Rodgers and Strelock will investigate the rumors, and expect to send more authentic news before the close of the summer.

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A letter has been received from Henry M. Stanley, the African explorer, dated Congo River, July 4, in which he states that he was seriously ill all through the month of May, so seriously that on the fifteenth day of his illness he gave, as he thought, his last orders to his European companions; but the crisis passed and he is now strong and hearty.

ASTRONOMY.

TRANSIT OF MERCURY AND NOTES FOR NOVEMBER, 1881.

BY W. W. ALEXANDER, KANSAS CITY, MO.

On the evening of the 7th at 59 minutes before sunset, the planet Mercury will begin its transit. The Kansas City Mean Time of the visible phases are:

Exterior Contact Ingress, 3h 57m 34s P. M.

Interior Contact Ingress, 3h 59m 17s P. M.

Apparent diameter of Mercury 9.9″, of the Sun 1910.6″.

The place where it will first appear on the Sun will be a little south of east, or 129° from the north point toward the east. The transit will not be visible to the naked eye, and need only be looked for with a telescope magnifying at least fifteen or twenty times.

THE SUN.

Date.	Right Ascension.	Declination S.	M. T. of Meridian Passage.
1st.	14h. 28m.	14° 38′	11h. 43m. 43s. A. M.
5th.	14 44	15 53	11 43 45
10th.	15 04	17 20	11 44 07
15th.	15 24	18 40	11 44 51
20th.	15 45	19 51	11 45 56
25th.	16 06	20 53	11 47 21
30th.	16 27	21 45	11 49 04

Semi-diameter on he 1st 16′ 10″, on the 30th 16′ 15″. Sidereal time of mean noon on the 1st, 14h. 44m. 41.04s., on the 15th, 15h. 39m. 52s., on the 30th 16h. 39m. 00s.

THE MOON.

Date.	Right Ascension.	Declination.	Semi-diameter.
1st.	23h. 03m.	0° 27′ S.	16′ 10″
5th.	2 38	17 52 N.	15 48
10th.	7 09	19 16	14 59
15th.	11 01	00 38	14 54
20th.	15 09	19 27 S.	15 49
25th.	20 08	15 56	16 15
30th.	0 34	8 35 N.	15 55

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MERCURY.

Date.	Right Ascension.	Declination S.	M. T. of Meridian Passage.
1st.	15h. 20m.	22° 26′	oh. 35m. P. M.
5th.	15 04	18 15	0 04
10th.	14 41	14 47	11 13 A. M.
15th.	14 27	12 28	10 43
20th.	14 31	12 20	10 30
25th.	14 48	13 46	10 29
30th.	15 11	15 54	10 34

VENUS.

Date.	Right Ascension.	Declination S.	M. T. of Meridian Passage.
1st.	12h. 49m.	3° 33′	10h. 05m. A. M.
5th.	13 08	5 27	10 08
10th.	13 31	7 48	10 12
15th.	13 54	10 05	10 15
20th.	14 18	12 16	10 20
25th.	14 42	14 20	10 24
30th.	15 07	16 15	10 29

Apparent diameter on the 1st, 11.6″, on the 30th, 10.8″. Sidereal time of the semi-diameter passing the meridian, 0.38s.

MARS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	7h. 00m.	23° 52′	4h. 14m. A. M.
5th.	7 04	23 57	4 01
10th.	7 06	24 06	3 44
15th.	7 08	24 18	3 26
20th.	7 08	24 32	3 06
25th.	7 06	24 50	2 44
30th.	7 03	25 19	2 21

It will rise on the 30th at 6h. 51m. P. M., and is in a very favorable position for observation in the evening.

JUPITER.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	3h. 22m.	17° 16′	oh. 35m. A. M.
5th.	3 20	17 08	0 17
10th.	3 17	16 58	11 55 P. M.
15th.	3 14	16 48	11 33
20th.	3 12	16 38	11 10
25th.	3 09	16 28	10 48
30th.	3 07	16 19	10 26

Apparent diameter on the 1st, 46.7″, on the 30th, 46.4″.

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SATURN.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	2h. 29m.	11° 57′	11h. 43m. P. M.
5th.	2 28	11 50	11 26
10th.	2 26	11 43	11 04
15th.	2 25	11 36	10 43
20th.	2 23	11 30	10 22
25th.	2 22	11 24	10 01
30th.	2 21	11 18	9 40

The apparent elements of its ring; outer Major Axis 45.3″, Minor Axis 14.4″. Inclination of northern semi-minor axis to circle of declination from north to east, 0° 01.1′. Elevation of the earth above the plane of the ring, 18° 37.5′, of the sun, 19° 26.7′. Earth's longitude from Saturn counted on plane of ring from the ring's ascending node on Equator, 89° 51′, on Ecliptic, 47° 07′.

URANUS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	11h. 14m.	5° 41′	8h. 26m. A. M.
15th.	11 16	5 28	7 33
30th.	11 18	5 19	6 36

NEPTUNE.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	2h. 54m.	14° 41′	00h. 07m. A. M.
15th.	2 52	14 34	11 10 P. M.
30th.	2 50	14 28	10 10

PHENOMENA.

On the 5th at 1h. 32m. P. M., conjunction of Saturn and the Moon. Saturn south 5° 29′.

On the 6th at 0h. 16m. A. M., conjunction of Neptune and the Moon. Neptune south 4° 02′.

On the 6th at 11h. 46m. A. M., conjunction of Jupiter and the Moon. Jupiter south 2° 48′.

On the 7th at 4h. 00m. A. M., opposition, Neptune and the Sun.

On the 7th at 6h. 50m. P. M., conjunction of Mercury and the Sun, inferior and transit.

On the 10th at 4h. 23m. P. M., conjuction of Mars and the Moon. Mars north 4° 44′.

On the 13th at 1h. 50m. A. M.. opposition of Jupiter and the Sun.

On the 16th at 2h. 07m. A. M., conjunction of Uranus and the Moon. Uranus north 6° 26′.

On the 17th at 1h. 00m. A. M.. Mercury stationary in right ascension.

On the 17th at 6h. 00m. A. M., Mars stationary in right ascension.

On the 19th at 6h. 20m. P. M., conjunction of Venus and the Moon. Venus north 4° 33′.

On the 20th at 1h. 13m. A. M., conjunction of Mercury and the Moon. Mercury north 5° 12′.

On the 24th, Mercury's greatest elongation, west 20° 00′.

REMARKABLE AURORAS.

BY PROF. S. A. MAXWELL, MORRISON, ILL.

A writer in the Albany, N. Y., *Argus*, gives an interesting account of the wonderful, luminous phenomenon, seen throughout a large portion of the north Atlantic States, on the evening of September 12th. The phenomenon here referred to, was a band of white light, about 12° in width, spanning the heavens from east to west.

It is evident that the writer is anxious to learn the real nature of this singular appearance; for notwithstanding the fact that a dozen or more theories were at once advanced to explain it, he still asks, "what was it?" An assistant at the Dudley Observatory, when interviewed, said that he did not dare to make any assertion in the matter, and concluded by saying, "It may have been an aurora, but so far as my knowledge goes, it was something unique."

It is probable that a similar phenomenon has not been heretofore witnessed by the people of Albany; at any rate, not at a time within the memory of the pres ent generation. Nevertheless there are people, even in that city, who claim to have observed such sights previous to the war.

Although the telephone wires were unaffected at the time of its occurrence, I believe that the phenomenon was one of the many forms of the aurora. My chief reason for this belief is, that on the night of Friday, October 14th, 1870, a similar phenomenon took place, while at the same time a genuine aurora lighted up the northern heavens, both with luminous arch and bands. This aurora somewhat suggested a vast wheel, the lower arch near the horizon forming the hub, the polar bnnds or streamers, representing the spokes, and the zenith arch, (like that seen at Albany,) the outer rim of the wheel.

At another time, the evening of Friday, April 2nd, 1869, I saw a similar luminous band, which extended across the heavens, almost from east to west, inclining toward the northwest and southeast. Neither this one, nor the one above noted, was over two or three degrees in width, but the light in both cases was of a pure white and tolerably well defined at the edges. In the phenomenon of April 2nd neither extremity extended quite down to the horizon; and about ten degrees from the western end, there was a bend that extremity lying more nearly horizontal than the other.

While one of these auroras, the one of October 14th, illumined the heavens, the lower arch was partially obscured by clouds, over whose corrugated surfaces,

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frequent flashes of lightning played, thus furnishing another element of sublimity to the scene.

In speaking of remarkable auroras, I cannot omit mentioning the one of September 24th, 1870. Many who read this will doubtless remember the event, though the precise date of its occurrence may have escaped their recollection. The characteristics of this most wonderful of auroras, were the large area over which it was visible, the extent of the visible heavens over which it spread; the variety and brilliancy of its colors, and the trembling waves of lambent light which ascended spirally toward a vortex a few degrees southwest of the zenith. The scene presented surpassed the power of description. I remember how the little patches of red light would vanish and reappear, almost before one had time to think; while others, if they disappeared, would not return again, or if they did, would be somewhat modified in color, in form, or in position. This aurora remained brilliant until about eleven o'clock, at which time it began to disappear, first along its southern border, which was but a few degrees above the horizon; after a short time it receded past the zenith, and at midnight there was nothing unusual in its appearance—being a simple arch of white light near the northern horizon, with perhaps a few inconspicuous streamers of the same color.

I do not know whether others have observed that the highest point of the arch of an aurora does not appear due north, but varies with magnetic declination. In this locality the aurora is brighest somewhat to the east of north. I find also that the vortex or corona of the last mentioned aurora was just about as many degrees to the south of the zenith, as the north magnetic pole of the earth is distant from the axial pole.

The mysterious band of light seen at Albany was probably, what I have stated, a mere auroral arch, but, appearing as it did, in the zenith, more nearly resembled a band than an arch. The same, viewed from a lower latitude would have presented an arch-like appearance, similar to those often seen by us in the distant north; and these latter would present to an observer beneath them, the same band-like appearance seen at Albany.

The observatory in the neighborhood of Nice, which is being erected at the expense of M. Bischoffsheim, is rapidly approaching completion. The great equatorial telescope is to be one of the largest in the world—perhaps the largest—as it will have an object-glass three feet in diameter and a focal length of upward of fifty feet. The construction of this monster telescope has been intrusted to MM. Paul and Prosper Henry, of Paris, and the total cost of the observatory will be more than $400,000 in American money.

METEOROLOGY.

REPORT FOR THE MONTH ENDING OCT. 20TH, FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during the month 29.36 in. on the 9th. Lowest barometer during the month 28.55 in. on the 29th.

Highest temperature during the month 95° on the 27th. Lowest temperature during the month 25° on the 5th.

Highest velocity of wind during the month 45 miles on the 24th. Number of miles traveled by wicd during the month 12,500.

Lunar halo on the 6th at 9 P. M.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Sept. 20th to 30th.	Oct. 1st to 10th.	Oct. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	53.0	50.7	42 2	48.6
Max	86.9	78 2	64.3	76.5
Min. and Max	70.2	64 3	52.6	63.0
Range	34.1	27.5	21.0	30.9
TRI-DAILY OBSERVATIONS.				
7 a. m.	67.7	63.3	47.0	59.3
2 p. m.	81.7	75.7	51.2	69.9
9 p. m.	70.8	65.2	52.9	63.0
Mean	72.9	69 0	52.1	64.7
RELATIVE HUMIDITY.				
7. a. m.	.71	.89	.92	.84
2 p. m.	.50	.64	.78	.64
9 p. m.	.61	.82	.88	.77
Mean	.61	.78	.85	.75
PRESSURE AS OBSERVED.				
7 a. m.	28.81	29.15	29 09	29.02
2 p. m.	28.79	29.10	29.04	28.98
9 p m.	28.80	29.11	29.05	28.99
Mean	28 80	29.12	29.06	28.99
MILES PER HOUR OF WIND.				
7 a. m.	18.3	11.2	14 7	14.7
2 p. m.	25.4	21.1	15.6	20.7
9 p. m.	15.2	16.0	16.7	16.0
Total miles	5104	3703	3693	12500
CLOUDING BY TENTHS.				
7 a. m.	4.8	8.1	9.6	7.5
2 p. m.	5.9	7.5	7.4	6.9
9 p m.	6.6	6.3	6.2	6.4
RAIN.				
Inches	.72	.48	3.71	4.91

ON THE CAUSE OF THE ARID CLIMATE OF THE WESTERN PORTION OF THE UNITED STATES.

BY CAPT. C. E. DUTTON, U. S. A., U. S. GEOLOGICAL SURVEY.

Read before Section B, American Association for the Advancement of Science, Cincinnati Meeting, August 18th, 1881.

Many questions arising in the study of western geology involve the consideration of the arid climate of the region, and I have frequently been led to inquire as to its cause. Arid climates are usually attributed to the passage of pre vailing winds over high mountain chains. As they ascend the mountains upon the windward sides they are cooled by the expansion due to diminished barometric pressure, their capacity for moisture is reduced and an abundant precipitation takes place. Descending upon the leeward sides these changes are reversed; the air is heated, its capacity for moisture is increased it becomes dry, and having been depleted of moisture is supposed to be incapable of yielding a copious supply to regions beyond. This explanation is no doubt good for some localities. Peru is a case in point and for that country it seems quite perfect. It is believed by many that it also explains the arid climate of the western half of the United States, and that the Sierra Nevada is the range which robs the winds of that region of the moisture which otherwise would make its vast expanse fertile. Reflection upon this case has led me to a different conclusion.

It is unquestionable that the Sierra Nevada abstracts a notable amount of moisture from the winds blowing from the Pacific. Mr. B. B. Redding, the Land Agent of the Central Pacific Railroad, has kept for several years excellent records of the rainfall at many stations in California and Nevada, and informs me that along the main road from Sacramento to the summit pass of the Sierra, the annual rainfall increases at the rate of one inch for every one hundred feet of altitude. At the summit the mean annual precipitation exceeds ninety inches. It is not improbable that this large amount is considerably exceeded at numerous points along the crest of the range. It seems clear therefore that the winds which blow over the Sierra are to some notable extent depleted of moisture and the effect must be to at least aggravate the aridity of the regions lying immediately east of the range. But I think it can be made evident that this effect is relatively not great, and that the elevated region of the west would be on the whole very nearly as arid as it now is if the Sierra Nevada were obliterated as a mountain range. Nor can the other and lower ranges lying east of the Sierra affect the case materially, for surely more than ninety per cent of the rain and snow which fall upon them are reëvaporated *in loco* and the atmosphere ultimately suffers no material loss of moisture.

When the winds blow constantly from a cool to a warmer region they become warm and therefore dry; and if they have no opportunity to take up more

moisture on the way the passage from a cool to a warm region is a sufficient cause of aridity. This is, I conceive, the state of affairs which determines the climate of the western mountain region. The winds blow constantly from the western quarters, being the "return-trades." Local winds and perhaps large cyclones occasionally turn the weathercock toward an easterly quarter, but the general drift of the great atmospheric ocean is ever from west to east.* This prevailing air drift comes from the Pacific and reaches the coast nearly or quite saturated with moisture. The quantity of moisture required for saturation is dependent chiefly upon temperature; and the temperature of the air as it reaches the coast is determined by oceanic conditions.

From the Aleutian Islands a coastwise ocean-current moves southward, having a breadth of 500 miles or more, and extending as far southward as the latitude of Cape St. Lucas. Off British Columbia and Alaska it may be regarded as a warm current relatively to the adjoining land. Off the Californias although its temperature rises notably with its southward movement it may be regarded as a relatively cool current. On the more northerly shores its effect is to make the climate of the adjacent coast warmer than it would otherwise be; and its effect on the more southerly shores is to make them cooler. Stated in another manner, the relation is such that the temperatures of the land areas in the high latitudes are lower than those of the ocean, while in the low latitudes they are higher. In the high latitudes, therefore, the winds blowing from the Pacific are cooled by the land; in the low latitudes they are warmed by it. Hence the precipitation is copious in the former regions and meager in the latter. Between the two belts where these opposite effects are pronounced is a region where they shade into each other, and though this intermediate region cannot be marked out by distinct boundaries it may still be said to exist in latitudes lying within the valley of the Columbia River.

The cause of an arid climate thus indicated may be regarded as generally operative throughout the western mountain region; and it will no doubt appear upon full consideration to be much more potent and widely extended in its action than any or even all of the mountain ranges could be. It is, however, greatly modified by the intervention of local causes, which occasionally mask or obscure it. The precipitation in different portions of the region is highly irregular and several modifying causes can be indicated which, though they do not nullify the more general one here set forth, frequently become much more conspicuous in their effects. For instance, it is well known that the heaviest rainfall in the United States, excepting possibly upon some mountain tops, occurs upon the coast of Oregon and Washington Territory. But as already indicated this is the locality where we find the neutral axis, so to speak, of the alleged causes favoring respectively humidity and aridity, and where their effects are at a minimum or even at zero. Moreover, the westerly winds saturated with moisture here strike the coastwise mountains, and are suddenly thrown upward several thou-

* This general statement requires some qualification when applied to southern Arizona and southern New Mexico, though it is in the main applicable even there.

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sand feet before they have had time to feel the heating effect of the land which is here very slight; and the precipitation is thus very copious. Descending to lower levels inland they soon become dry and produce a sub-arid climate.

The most frequent variants of climate are the great differences of altitude in different portions of the west. The mountain tops and summits of the plateaus are always well watered, and in any given latitude the rainfall increases or diminishes at a fairly definite rate with the altitude. But the variation of rainfall with altitude is by no means a simple ratio. Between 4500 and 6000 feet the difference in rainfall is not great; between 6000 and 7500 feet it is very considerable; between 7500 and 9000 it is still greater.

Moreover the rainfall is greater, *ceteris paribus*, in high latitudes than in low latitudes. In passing from the southern to the northern boundary, if we compare localities of equal altitudes along any given meridian, we shall find the rainfall steadily, though perhaps not uniformly increasing. This is an obvious consequence of the theory suggested.

Although no very great effects upon the general condition of aridity are here attributed to the depletion of moisture by the passage of the winds over mountain ranges, it is still true, no doubt, that highly important local effects are thereby produced. The rainfall at the eastern base of the Sierra Nevada, and for two hundred miles east of it, is most probably reduced very greatly by this cause. In the sink of the Humboldt River, the annual precipitation seldom reaches four inches, and may average not more than three inches. But as we pass eastward, beyond the *wake* of this range, its effects become gradually less; and long before the Wasatch is reached they have become inconsiderable. Since the Sierra Nevada is the longest, highest and widest of the individualized ranges of the Rocky system, its local effect upon the humidity of the plains and valleys lying immediately under its lee is greater than that of any other. But the same kind of effect is preceptible in some other ranges.

The discussion of the causes of local variations in climate might be almost indefinitely extended. Nothing more is designed here than to advert to one general cause of aridity which prevails over the entire region, and which everywhere exists, though it is often obscured, sometimes reversed and sometimes reinforced, by local causes.—*American Journal of Science.*

MEDICINE AND HYGIENE.

THE PROPER LIMITS OF PHYSICAL CULTURE.

BY W. B. SAWYER, M. D., KANSAS CITY, MO.

The questions of physical culture are pre-eminently those of this day. The college curricula of half a century ago contained no allusions to cultivation of the bodily powers, and society took no heed of how its members cared for them. The pendulum of fashion has swung far, however, away from this point of apathy and is rapidly approaching, if it has not reached, the opposite one of excess. To-day colleges, schools, towns, cities, and private societies are furnishing gymnasia for indoor exercises and expensive apparatus and stimulating prizes for excellence in outdoor athletics. The college graduate of the present is expected to be an expert oarsman, runner, or base-ball player, while nearly every young man is anxious to excel in feats of power. Will it not be well to question then what proper physical culture is and what needs it should aim to supply?

To begin with, all men are given, as part of the capital with which to gain a livelihood, bodies which, to say nothing of the wonderful beauty symmetry and nicety of their various arrangements, are precisely adapted for any calling in life which they may assume. They are also gifted, as the feature that distinguishes them from the brute creation, with intellect, and herein lies the point of their responsibility. The animal is guided in the care of his body only by instinct. When he is thirsty he drinks, when hungry seeks food, when frightened flees from the cause of his fear. All animals, saving man, have also provided for them, each in their separate kind, certain peculiar organs, functions and developments, which take for them, to a certain extent, the place of reasoning faculties. Thus the coat of horses, cattle, and fur-producing animals is thick for the cold of winter, is shed and comes again thinner when the warm months appear; certain classes of them are fitted entirely for a diet of herbs and others for meats alone, and to prevent the possibility of their mistaking the one for the other, or of manifesting any choice in the matter, they are each provided with teeth of such a kind as to admit of masticating the one, and not the other. So also to every created brute has been given just those qualities, organs, and instincts as are required by his peculiar characteristics. The bird has his light bones, broad wings and extensive lungs to prepare him for his aërial navigation. The water-fowl his broad web-feet for swimming, and the wonderful capacity for retaining air in the body.

Look over the entire range of animal nature in fact, and we see that whatever element the animal is to live and move in or upon, and whatever instinctive, natural traits he has, for the enjoyment and performance of them, he is provided

with the necessary appliances. But with animal nature, guided alone by instinct, within very narrow limits, there is no possibility of change, or of extending the range of the capabilities given by nature. The elephant can not fly, nor can the tiger eat grass like the ox. The bear of the pole can not live beneath the sun of the tropics, nor the fish of the sea upon dry land. Each brute must carry out the single purpose of his life, and must tread the one path marked out for him in the original plan. When we consider man, however, we find another structure and functions, and vastly greater capabilities.

To the body, with its organs and functions and all the so-called natural instincts, is added the mind with all its powers of thought, will and passion. With a body, not especially fitted for any one sphere of activity, or style of life, but wonderfully adapted for all, is joined an intellect to provide the means for any sort of action or change, a will to carry out any proposed deflection from ordinary animal life and a power of judgment to decide what to do for the body at all times, and in all places, thus to protect it from what might be the direful consequences of extensive changes. To illustrate—instead of being furnished with a covering of hair, feathers, or scales, man is given ability to make clothing for himself, and to adapt it to the conditions of the surrounding atmosphere. Without being limited in his diet to herbs or to flesh, he is given his choice, and delicate sensibilities of taste, with reason to guide it. He is not made swift of foot to flee from his enemies; not provided with natural weapons to protect himself from them, but is given inventive powers whereby he can procure for himself the swiftest locomotion and the surest tools of defense.

Now this connection of mind and matter—and all philosophy since the world began has never been able to say how or where it is made—is not a simple copartnership, entered into by the mind on the one side and the body on the other, for mutual benefit, and from which either partner may withdraw at pleasure, but wherever it is made, or however the bond is cemented, it is absolute, indissoluble and ending only with death. It is a union in which the one party is dependent on the other, and when one suffers the other feels the result. In this is the need, and in this the reason for physical culture. Men can not forget their bodies, for upon them equally with dependence upon their mental qualifications depend the hopes they may have for the highest attainments. An even, perfect balance of all powers is the thing to be sought after. A fine mind in a misshapen, weak, or undeveloped body is the mournful sight, too often seen, which comes as a result of a neglect of some law of nature, and a huge body, or even a graceful and highly developed one, coupled with a shallow brain is just as surely the result of negligence or malicious training. Remembering then, that when we attempt physical culture our object should be to make the body the fit companion and dwelling-place of a well-cultured intellect, and that that intellect may have the fullest powers of endurance, quickness and energy at its command, and that when we seek mental culture we are but perfecting the engine that it may produce the most, and the most perfect results from its machinery, the body, we are prepared to consider what constitutes proper physical culture and how it may be

attained. When we speak of physical culture, in the minds of many will at once arise the remembrance of some great athlete we may have seen or known; and vision of red, brawn, sinewy limbs, great knotted muscles, and wondrous feats of arms and legs will appear. But true physical culture is a term whose significations should not be narrowed to the consideration of a culture whose end is only the development of one part and phase of the physique. It is the cultivation to the furtherest extent in the safest way, and to the full possibility, of every organ and function of the body. The hardest limbs may be but the overgrown and over-educated accompaniment of a weak heart or dyspeptic stomach, or may lead to them. The swiftest runner may forget that the lungs need training as well as the legs, and a consumptive may thus have cause to remember his races, and repent them. But more likely then either, the stomach, lungs or heart to be forgotten in the effort for high bodily powers, are the most important organs of all. The nerves doing their duties as messengers and stimulators, from the commander, the brain, to its subjects the muscles, silently motionlessly, and with all the mystery of a perfect telegraph system, are most liable to be forgotten and left to care for themselves, or more often, are taxed beyond their capabilities and irreparably injured for life. The strain must be equal and every function carried systematically to its fullest development.

Physical culture should keep pace with mental development, bodily exercise accompany and supplement intellectual work. The amount of physical exercise should be just enough and of just such a kind as will rest the mind and divide with it the burden of life and work. It should be neither prolonged nor excessive, and should be constant and regularly taken. Each brain must be the judge of how much and what variety of exercise the body that houses and serves it demands. The hard worked clerk who stands for hours in the close atmosphere of a store does not require the gymnasium as much as he does the open air, nor exercise for his legs as much as he does for his lungs, while many a busy man whose calling keeps him in the street can find exactly what he needs only on the horizontal bars or with the Indian clubs. The part to be worked and stimulated should be the one most neglected. Yet the proper care of the body means care of the whole body, and watch must be kept on all sides lest some function be overdone at the expense of some equally important one. The safe course is to test them all from time to time and build up and revivify the weaker ones as occasion may demand, not forgetting that moderation is a physical as well as a moral virtue.

MEISO.

BY PROF. D. P. PENHALLOW, LATE OF THE IMPERIAL AGRICULTURAL COLLEGE OF JAPAN.

It is well known that the Japanese are a rice-eating people, with whom this article, Meiso, is perhaps, the most important of all their foods, but it is not so generally known that the flesh of animals could hardly be considered a regular

article of food until within the past few years, and even now, with the great mass of the people, meat is seldom used. Thus for centuries, these people have lived almost wholly without that which western people consider so important a source of nitrogen. It seems, however, that the demands of Nature were recognized and met by obtaining from the vegetable kingdom what they failed to secure from the animal, and thus it is we find them consuming enormous quantities of beans prepared in a great variety of ways. Some of the important preparations from beans are cheese, or tofu—a white, curdy mass strongly resembling cottage cheese, unflavored with salt and held in high estimation. It is prepared in a variety of of ways, but almost invariably forms a part of every meal as a constituent of soup: Cake—a stiff, jelly-like confection made by straining boiled beans and incorporating with a large proportion of sugar. Pickles—beans in the pod and frequently on the stem, pickled in a strong brine; they are eaten without further preparation. Sugared Beans—roasted beans enveloped in a heavy coating of sugar and sold as a confection. Shoyu, or Soy—a liquid of dark color and salty flavor, made by fermenting a mixture of salt, beans and roasted wheat or barley. It is largely eaten with fish and rice. There are other modes of preparation which we will pass over with the exception of Meiso, which forms the subject of this article.

The pasty mass manufactured and sold under this name, constitutes one of the most important of the preparations from beans, and enters largely into the diet of all clases as a basis for soup, or, in various forms, as a sauce for fish and meat. In composition it consists of

Salt	4.5 to=2.30 bushels.
White Beans	1 koku=5.13 "
Rice	4 to=2.05 "

SALT.—The salt employed is of a very crude sort. It is obtained from sea water by evaporation under the influence of solar heat, and as no attempts are made to secure any special degree of purity, it is consequently contaminated with other salts and its specific value thereby lessened. Sticks, straw—especially from the coarse bags in which it is transported—and dirt are also always to be found, and as no efforts to cleanse or purify, beyond removal of the larger fragments of straw, etc., are made at the factory, the product into which such salt enters has a rather uninviting appearance. It is always used dry.

BEANS.—The ordinary white beans appear to be used in preference to any others. They are prepared by boiling for about six hours, when the fire is drawn and they are allowed to cool in the boiler. The next morning they are removed from the boiler and placed in mash boxes which measure 10x3x1 feet, where they are thoroughly reduced and mixed with the rice and salt by means of a round pole used as a pestle.

RICE.—White rice, or that which has been well cleaned, is soaked in cold water for two days. It is then well drained and transferred to a boiler containing fresh water, when it is steamed for three hours. While yet hot, it is taken to a

warm room and allowed to remain under the influence of a warm, moist air for four days, when the whole is found to be covered with an abundant growth of fungus.

The room in which this operation is performed, usually measures about 10x20 feet, is constructed of mud walls—eight or ten inches in thickness, and is made as close as possible with the exception of one small window to admit light for the workmen, and a door through which to enter,. The only moisture in the room is that which comes from the moist rice, but a constant temperature of 80° F. is maintained by means of a large charcoal fire at each end of the room. It is regarded that a warm, moist air undisturbed by draughts, is quite essential to the success of the operation, though darkness is not deemed requisite, the absence of windows being more a matter of economy than anything else. The production of the fungus is usually regarded as the critical part of the whole manufacture, and failure sometimes occurs. No reason could be obtained from the Japanese why the subsequent fermentation is dependent upon the presence of the fungus; that its production is an essential part of the process, was all the information that could be obtained.

At the end of four days, the rice is taken out into a large airy room and spread upon straw mats, 3x6 feet, and allowed to cool for one and one-half hours. It is then transferred to small trays which measure 18x8x1½ inches, for convenience in handling, when it is allowed to cool as rapidly as it can. Whether the rice now dries or remains moist, appears to be a matter of indifference. As soon as thoroughly cooled, it is incorporated with the salt and beans. It is generally customary, however, to prepare the rice in large quantities once in four days, and thus have a stock always on hand. In that case, as soon as cooled, it is mixed with the salt and placed in large storage vats where it is tamped solid by the feet, and will then keep without trouble for two months.

When all the ingredients have been thus prepared, they are placed, cold, in the mixing boxes already described, and thoroughly incorporated into a stiff, pasty mass by means of a long mixing rod. This mixture is then placed in large vats having a capacity of about seventeen koku or eighty-seven bushels. Here it is packed solid by the feet and allowed to undergo a very slow fermentation. Every effort is made to keep the temperature of the mass down as low as possible, and if, during the summer, the heat of fermentation gets too great, the whole mass spoils. It is then mixed with roasted wheat and by further fermentation converted into shoyu or soy. Sometimes the mixture fails to ferment properly, when it is taken out and mixed with a fresh portion of beans. The fermentation is allowed to continue six months in summer and eight months in winter, at the end of which time the meiso is ready for the market.

The result of these various operations is a stiff, pasty mixture of repulsive appearance and disagreeably sour odor, and though it would hardly find favor with Americans or Europeans, possibly excepting epicures, it seems to be in great demand with the Japanese.

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The factory where these facts were obtained, employs six men, and the annual produce amounts to from 900 to 1,000 koku, equal to 4,617 to 5,130 bushels. The cost of the various ingredients and the finished product is as follows:*

Beans, 1 koku—5.13 bu.	6	yen†
Rice, 1 koku.	10	"
Salt, 1 koku.	5.40	"
Total cost of Meiso per koku	7.13	"
Market price per koku	13.20	"

The moldy rice, prepared as described, constitues the yeast of the Japanese and is used for all the purposes, including bread-making, for which we would employ ordinary yeast. Its production is therefore of considerable importance, as upon it depends the manufacture of meiso, saki, (fermented liquor,) vinegar, and shoyu. It therefore becomes evident that the principal interest of this entire manufacture centers in the fungus which develops upon the rice, because of the variety of forms which may be developed from its spores under different conditions of warmth and moisture, and, also, exposure to the air.

In order to obtain some satisfactory evidence on this interesting subject, the various products—moldy rice, meiso, yeast and vinegar—were submitted to microscopical examination.

A sample of meiso was taken from a vat where fermentation had been in progress for some time. It was noticed that the temperature was so low, that the whole mass felt cold to the hand, and thus whatever fermentation was in progress, must have been going on at a very slow rate. On examination, there appeared numerous spore-like bodies, similar in form and size to the spores from the moldy rice, which they doubtless were. In addition, there were many short and irregularly branched filaments in all stages of growth from the spore. Nothing was seen which could be called yeast-plant proper, or *S. cerivisicæ*.

A sample of freshly made vinegar, showed the liquid to contain a very large number of spermatia-like bodies, while masses of the true vinegar-plant were also numerous. The cells of these measured 1-7000 of an inch in diameter. No true yeast-plant was to be found, though this may possibly have been due to the degree of saccharine exhaustion as well as the low temperature of the fermentation. A sample of vinegar, containing a good surface growth of the vinegar-plant, was kept for three weeks in the hope that fruit might appear and thus furnish one more link in the chain of evidence; but none appeared, although the net-work of cells constantly and rapidly increased, and further observations were interrupted by departure for home.

Yeast made in the ordinary way, but using the moldy rice to start the ferment, showed the familiar forms of the true yeast-plant. The fungus on the moldy rice, proved to be our old friend *Penicilleum*.

* Prices for 1880; probably somewhat higher at present.
† Yen, gold, is equal to the U. S. dollar.

These observations furnish us with a practical illustration of the fact that these vegetable structures of low degree of organization, are not necessarily constant in form and structure, but are liable to vary greatly under different conditions of temperature, moisture and exposure, and that they are associated with fermentation of varying rapidity as well as with products which are more or less dissimilar. They furnish one instance of the effect which environment has upon the individual.

BOOK NOTICES.

ANTHROPOLOGY. By Edward B. Tylor, D. C. L., F. R. S., with illustrations; pp. 448, 12mo., New York, D. Appleton & Co., 1881.

This work is announced as "an Introduction to the Study of Man and Civilization" and it is at least safe to say that no better one has been presented by any author. It covers the whole subject of the science of Man and, without dry and burdensome technicalities, places before the student all that is necessary for him to know before commencing his own investigations or the study of elaborate works devoted to special branches or departments of Anthropology.

The scope of the work is fully shown by the titles of the chapters: Man, Ancient and Modern; Man and other Animals; Races of Mankind; Language; Language and Race; Writing; Arts of Life; Arts of Pleasure; Science; The Spirit World; History and Mythology, and Society. All of these subjects are fully illustrated with appropriate and excellent engravings, and the author has presented his theme in a logical and progressive form from beginning to end of the volume. No writer of the present day has had greater experience nor made more careful researches in this field, nor is any more happy in expressing himself acceptably to the general reader. His introductory chapters on Man, Ancient and Modern, and on Man and other Animals, bring the whole subject before the student in a condensed yet comprehensive form, and serve as a foundation, not only for his (the author's,) subsequent chapters, but also for the student to build upon, no matter how extensive his future researches may be.

To any one intending to make Anthropology a specialty, no work that we know of is so fitting as a preliminary text book and guide.

ILLUSIONS: A PSYCHOLOGICAL STUDY. By James Sully, New York; D. Appleton & Co., 1881. For sale by M. H. Dickinson, $1.50.

This work is the thirty-third volume of the International Scientific Series, and is one of the most interesting of that valuable series. The author takes a wide survey of the field of error, embracing in its view not only the illusions of sense dealt with in treatises on physiological optics, etc., but also other errors

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familiarly known as illusions and resembling the former in their structure and mode of origin. The points treated are as follows: The Study of Illusion; the Classification of Illusion; Illusions of Perception, general, active and passive; Dreams; Illusions of Introspection; Other Quasi-Presentative Illusions; Errors of Insight; Illusions of Memory; Illusions of Belief; Results. The whole contained in twelve chapters, covering three hundred and seventy-two pages.

Starting with statement that the flattering supposition of common sense that illusion is essentially an incident in abnormal life is so erroneous that many regard it as the natural condition of mortals, he takes the middle ground that most men are sometimes liable to illusion. From this position he follows the subject as above indicated, having due regard to the physiology as well as the pathology of mind. The chapter on Dreams will be found especially interesting to the general reader from the comprehensive and practical manner in which the subject is handled. Various theories of dreams are considered, but the conclusion is reached that they are to a large extent the semblance of external perceptions, their materials drawn from our waking experiences and that they are largely intelligible by help of the physiological and psychological principles previously considered. In explaining dreams the the condition of the organism in sleep is first set forth, then the dream state, the causes of dream illusions, such as the action of external and internal stimuli; dream exaggeration, dream hallucinations, effects of direct and indirect central stimulation, combination of dream elements, incoherence of dreams, their coherence, the lyrical element in dreams, etc.

The whole book is the work of a careful student, a skillful physiologist and a logical thinker, and it is full of valuable information and suggestions.

THE OLD TESTAMENT IN THE JEWISH CHURCH. By W. Robertson Smith, M. A.; 12mo., pp. 446; D. Appleton & Co., New York, 1881. For sale by M. H. Dickinson, $1.75.

Biblical criticism in the scholarly sense includes the most careful examination and weighing of every expression of every prophet, historian, psalmist and apostle whose writings are found in the Bible; differing in the widest degree from the Bible reading of the ordinary student whose search is either wholly devotional or perhaps for doctrinal purposes. In the first case the reader puts himself as far as possible in the exact position of the writer and interprets his words and thoughts by means of a full comprehension of his surroundings; tracing the successive steps of religious progress in the world from the simple sacrificial offerings of Cain and Abel to the vicarious sacrifice of Jesus Christ; in this way arriving at an exhaustive and complete, critical knowledge of the Bible. In the other case certain portions are selected, which, on account of their precious promises or their pathos, or their wondrous revelations of the future life, or some other practical quality, arouse the sympathies or strengthen the faith of the reader. Necessarily this latter manner of study leaves out of consideration a large portion of the

Bible which does not direct itself immediately to the emotions, and is essentially imperfect.

The work before us is devoted to pointing out the true method of Biblical study, being the substance of a series of lectures delivered by the author in Edinburgh and Glasgow during the first three months of 1881. The points discussed are Criticism and the Theology of the Reformation; Christian Interpretation and Jewish Tradition; The Scribes; The Septuagint; The Canon; The History of the Canon; The Psalter; The Traditional Theory of the Old Testament History; The Law and the History of Israel before the Exile; The Prophets; The Pentateuch; The First Legislation; The Deuteronomic Code and Levitical Law.

In all of these the scholarship of the author manifests itself clearly, while his expositions of doubtful passages are palpably clear and conclusive. We regard the word as one of the most interesting of the kind that we have ever seen, well worthy of the study of all Bible readers and teachers.

FARM FESTIVALS. By Will Carleton; illustrated; New York. Harper & Brothers, 1881. For sale by M. H. Dickinson, $2.00.

Will Carleton has become by common consent, *par excellence*, the acknowledged ballad writer of America. His series of Farm Ballads was and is widely read, and the present volume can but add to his reputation in this respect. His subjects are well chosen and his treatment of them will bring freshly to the memory of his older readers, at least, scenes of their youth long forgotten perhaps, the arousing of which will be grateful and care-dispelling. Many gems of genuine poetry gleam among his verses, and the whole work will be found bright and attractive in all respects.

JOURNAL OF A FARMER'S DAUGHTER. By Elaine Goodale; pp. 183, 12mo.; G. P. Putnam's Sons, New York, 1881. For sale by M. H. Dickinson, $1.00.

The papers comprised in this volume were principally published in the *Christian Union* under the title of a "A Summer Journal," and as such attracted considerable attention, from the elegance of the writer's style and the truthfulness of her descriptions. Graceful poetry and dainty prose combine to make the book readable and attractive. The period covered is from April 2nd to November 30th, and a page or two is given to nearly every day of this time; all filled with appropriate, glowing descriptions, graceful pen pictures of and sparkling allusions to the beauties of nature in the country.

For a city reader, penned up in a narrow home and hemmed in by dusty streets and dingy warehouses, there can be no more pleasant or piquant reading.

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OTHER PUBLICATIONS RECEIVED.

Report of Professor Spencer F. Baird, Secretary of the Smithsonian Institution, for 1881; A Synopsis of the Scientific Writings of Sir William Herschel, prepared by Prof. Edward S. Holden and Charles S. Hastings; An Account of Recent Progress in Geology and Mineralogy for the years 1879 and 1880, by Geo. W. Hawes, Ph. D., curator of the National Museum; An Account of Recent Progress in Physics and Chemistry for the years 1879 and 1880, by Prof. Geo. F. Barker; An Account of Recent Progress in Astronomy for the years 1879 and 1880, by Prof. E. S. Holden; Bulletin No. 6, General Index and Supplement to the Nine Reports on the Insects of Missouri, by Prof. Charles V. Riley, M. A., Ph. D.; Apportionment under the Tenth Census of the U. S., with remarks by Hon. S. S. Cox, M. C.; Fourteenth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology, Prof. F. W. Putnam, Curator; Explorations in Idaho and Montana in 1878, Prof. E. L. Berthoud; Science Teaching in District Schools, Prof. Paul Schweitzer, Ph. D.; Priced and Classified List of Works on Political Economy and Political Science, W. G. Sumner, David A. Wells, W. E. Foster, R. L. Dugdale and G. H. Putnam; Seventh Annual Report of the Board of Education of District No. 1, Denver, Colorado.

SCIENTIFIC MISCELLANY.

FIFTY YEARS' PROGRESS IN SCIENCE.

BY SIR JOHN LUBBOCK, PRESIDENT OF THE BRITISH ASSOCIATION.

* * Certainly this is an opportunity on which it may be well for us to consider what have been the principal scientific results of the last half-century, dwelling especially on those with which this Association is more directly concerned, either as being the work of our own members, or as having been made known at our meetings. * * My best course will be to take our different Sections one by one, and endeavor to bring before you a few of the principal results which have been obtained in each department.

The Biological Section is that with which I have been most intimately associated, and with which it is, perhaps, natural that I should begin.

Fifty years ago it was the general opinion that animals and plants came into existence just as we now see them. We took pleasure in their beauty; their adaptation to their habits and mode of life in many cases could not be overlooked or misunderstood. Nevertheless, the book of Nature was like some richly illum-

inated missal, written in an unknown tongue; the graceful forms of the letters, the beauty of the coloring, excited our wonder and admiration; but of the true meaning little was known to us; indeed we scarcely realized that there was any meaning to decipher. Now glimpses of the truth are gradually revealing themselves; we perceive that there is a reason—and in many cases we know what that reason is—for every difference in form, in size and in color; for every bone and every feather, almost for every hair. Moreover, each problem which is solved opens out vistas, as it were, of others perhaps even more interesting. With this great change the name of our illustrious countryman, Darwin, is intimately associated, and the year 1859 will always be memorable in science as having produced his great work on "The Origin of Species." In the previous year he and Wallace had published short papers, in which they clearly state the theory of natural selection, at which they had simultaneously and independently arrived. We cannot wonder that Darwin's views should have at first excited great opposition. Nevertheless from the first they met with powerful support, especially, in this country, from Hooker, Huxley and Herbert Spencer. The theory is based on four axioms:—

"1. That no two animals or plants in nature are identical in all respects.

"2. That the offspring tend to inherit the peculiarities of their parents.

"3. That of those which come into existence, only a small number reach maturity.

"4. That those, which are, on the whole, best adapted to the circumstances in which they are placed, are most likely to leave descendants."

Darwin commenced his work by discussing the causes and extent of variability in animals, and the origin of domestic varieties; he showed the impossibility of distinguishing between varieties and pointed out the wide differences which man has produced in some cases—as, for instance, in our domestic pigeons, all unquestionably descended from a common stock. He dwelt on the struggle for existence (which has since become a household word), and which, inevitably resulting in the survival of the fittest, tends gradually to adapt any race of animals to the conditions in which it occurs

While thus, however, showing the great importance of natural selection, he attributed to it no exclusive influence, but fully admitted that other causes—the use and disuse of organs, sexual selection, etc.—had to be taken into consideration. Passing on to the difficulties of his theory he accounted for the absence of intermediate varieties between species, to a great extent, by the imperfection of the geological record. Here, however, I must observe that, as I have elsewhere remarked, those who rely on the absence of links between different species really argue in a vicious circle, because wherever such links do exist they regard the whole chain as a single species. The dog and jackal, for instance, are now regarded as two species but if a series of links were discovered between them they would be united into one. Hence in this sense there never can be links between any two species, because as soon as the links are discovered the species are united. Every variable species consists, in fact, of a number of closely connected links.

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But if the geological record be imperfect, it is still very instructive. The further paleontology has progressed the more it has tended to fill up the gaps between existing groups and species, while the careful study of living forms has brought into prominence the variations dependent on food, climate, habitat, and other conditions, and shown that many species long supposed to be absolutely distinct are so closely linked together by intermediate forms that it is difficult to draw a satisfactory line between them. Thus the European and American bisons are connected by the *Bison priscus* of Prehistoric Europe; the grizzly bear and the brown bear, as Busk has shown, are apparently the modern representatives of the cave bear; Flower has pointed out the paleontological evidence of gradual modification of animal forms in the Artiodactyles; while among the Invertebrata, Carpenter and Williamson have proved that it is almost impossible to divide the Foraminifera into well-marked species; and, lastly, among plants, there are large genera, as, for instance, *Rubus* and *Hieracium*, with reference to the species of which no two botanists are agreed.

The principles of classification point also in the same direction, and are based more and more on the theory of descent. Biologists endeavor to arrange animals on what is called the "natural system." No one now places whales among fish, bats among birds, or shrews with mice, notwithstanding their external similarity; and Darwin maintained that "community of descent was the hidden bond which naturalists had been unconsciously seeking." How else, indeed, can we explain the fact that the framework of bones is so similar in the arm of a man, the wing of a bat, the fore-leg of a horse, and the fin of a porpoise—that the neck of a giraffe and that of an elephant contain the same number of vertebræ?

Strong evidence is, moreover, afforded by embryology; by the presence of rudimentary organs and transient characters, as, for instance, the existence in the calf of certain teeth which never cut the gums, the shrivelled and useless wings of some beetles, the presence of a series of arteries in the embryos of the higher Vertebrata exactly similar to those which supply the gills in fishes, even the spots on the young blackbird, the stripes on the lion's cub; these, and innumerable other facts of the same character, appear to be incompatible with the idea that each species was specially and independently created; and to prove, on the contrary, that the embryonic stages of species show us more or less clearly the structure of their ancestors.

Darwin's views, however, are still much misunderstood. I believe there are thousands who consider that according to his theory a sheep might turn into a cow, or a zebra into a horse. No one would more confidently withstand any such hypothesis, his view being, of course, not that the one could be changed into the other, but that both are descended from a common ancestor.

No one, at any rate, will question the immense impulse which Darwin has given to the study of natural history, the number of new views he has opened up, and the additional interest which he has aroused in, and contributed to, Biology. When we were young we knew that the leopard had spots, the tiger was striped, and the lion tawny; but why this was so it did not occur to us to ask; and if we

had asked no one would have answered. Now we see at a glance that the stripes of the tiger have reference to its life among jungle-grasses; the lion is sandy, like the desert; while the markings of the leopard resemble spots of sunshine glancing through the leaves. Again, Wallace in his charming essays on natural selection has shown how the same philosophy may be applied even to birds' nests—how, for, instance, open nests have led to the dull color of hen birds; the only British exception being the kingfisher, which as we know, nests in river-banks. Lower still, among insects, Weismann has taught us that even the markings of caterpillars are full of interesting lessons; while, in other cases, specially among butterflies, Bates has made known to us the curious phenomena of mimicry.

The science of embryology may almost be said to have been created in the last half-century. Fifty years ago it was a very general opinion that animals which are unlike when mature, were dissimilar from the beginning. It is to Von Baer, the discoverer of the mammalian ovum, that we owe the great generalization that the development of the egg is in the main a progress from the general to the special, that zoölogical affinity is the expression of similarity of development, and that the different great types of animal structure are the result of different modes of development—in fact, that embryology is the key to the laws of animal development.

Thus the young of existing species resemble in many cases the mature forms which flourished in ancient times. Huxley has traced up the genealogy of the horse to the Miocene Anchitherium, and his views have since been remarkably confirmed by Marsh's discovery of the Pliohippus, Protohippus, Miohippus and Mesohippus, leading down from the Eohippus of the early Tertiary strata. In the same way Gaudry has called attention to the fact that just as the individual stag gradually acquires more and more complex antlers: having at first only a single prong, in the next year two points, in the following three, and so on; so the genus, as a whole, in Middle Miocene times, had two pronged horns; in the Upper Miocene, three; and that it is not till the Upper Pliocene that we find any species with the magnificent antlers of our modern deer. It seems to be now generally admitted that birds have come down to us through the Dinosaurians, and, as Huxley has shown, the profound break once supposed to exist between birds and reptiles has been bridged over by the discovery of reptilian birds and bird-like reptiles; so that, in fact, birds are modified reptiles. Again, the remarkable genus Peripatus, so well studied by Moseley, tends to connect the annulose and articulate types. Again, the structural resemblances between Amphioxus and the Ascidians had been pointed out by Goodsir; and Kowalevsky in 1866 showed that these were not mere analogies, but indicated a real affinity. These observations, in the words of Allen Thompson, "have produced a change little short of revolutionary in embryological and zoological views, leading as they do to the support of the hypothesis that the Ascidian is an earlier stage in the phylogenetic history of the mammal and other vertebrates."

The larval forms which occur in so many groups, and of which the Insects afford us the most familiar examples, are, in the words of Quatrefages, embryos,

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which lead an independent life. In such cases as these external conditions act upon the larvæ as they do upon the mature form; hence we have two classes of changes, adaptational or adaptive, and developmental. These and many other facts must be taken into consideration; nevertheless naturalists are now generally agreed that embryological characters are of high value as guides in classification, and it may, I think, be regarded as well-established that, just as the contents and se quence of rocks teach us the past history of the earth, so is the gradual develop. ment of the species indicated by the structure of the embryo and its developmental changes.

When the supporters of Darwin are told that his theory is incredible, they may fairly ask why it is impossible that a species in the course of hundreds of thousands of years should have passed through changes which occupy only a few days or weeks in the life-history of each individual?

The phenomena of yolk-segmentation, first observed by Prevost and Dumas, are now known to be in some form or other invariably the precursors of embryonic development; while they reproduce, as the first stages in the formation of the higher animals, the main and essential features in the life-history of the lowest forms. The "blastoderm" as it is called, or first germ of the embryo in the egg, divides itself into two layers, corresponding, as Huxley has shown, to the two layers into which the body of the Cœlenterata may be divided. Not only so, but most embryos at an early stage of development have the form of a cup, the walls of which are formed by the two layers of blastoderm. Kowalevsky was the first to show the prevalence of this embryonic form, and subsequently Lankester and Haeckel put forward the hypothesis that it was the embryonic repetition of an ancestral type, from which all the higher forms are descended. The cavity of the cup is supposed to be the stomach of this simple organism, and the opening of the cup the mouth. The inner layer of the wall of the cup constitutes the digestive membrane, and the outer the skin. To this form Haeckel gave the name Gastræa. It is, perhaps, doubtful whether the theory of Lankester and Haeckel can be accepted in precisely the form they propounded it; but it has had an important influence on the progress of embryology.

[*To be Continued*]

INDUSTRIES OF SWEDEN AND NORWAY.

Although in Norway and Sweden there are many mines and mills, most of the people gain their living either out of the soil or the sea. The farmer in either country is a marvel of industry and thrift; he would live upon what an American farmer wastes, and live more comfortably than our farming population do, as a rule. The amount of labor performed at the special dairy farms, to which cattle are driven in summer, generally by girls, would horrify a western maiden; but the Swedish and Norwegian girls thrive on it, enjoying rare good health and

consequent happiness. Still more exacting is the home care of cattle in winter, when much of the food must be specially prepared. On some soil that here would be condemned as good for nothing, fair crops are grown and harvested in the short summer, while in the southern provinces the yield is equal to that of model farms in America.

The maritime statistics of the two countries, and of Norway in particular, are simply staggering. Last year more than a thousand Norwegian vessels entered the port of New York, and seven times as many were busy elsewhere. More than sixty thousand sailors man these vessels, and yet Norwegian sailors are numerous in the merchant navy of almost every other country. About a hundred and twenty thousand Norwegians are engaged in the fisheries. The author minutely describes the great fishing stations of Norway, and here, as elsewhere, is struck by the attention paid by the government to all its resources. Every fishing station has a superintendent, appointed by the government, and the date of beginning the season's work, the time of starting out for the day, and even the places in which the fish are prepared for market, are determined by him; but the officer's duties seem to consist principally in preventing confusion or bad feeling. No liquor is sold at fishing stations, and yet the men, who are directly in the path of all the "American weather" that crosses the Atlantic, are a remarkably healthy and vigorous set of fellows; they wear good clothes, too, which is not done by fishermen in general. To their abstemiousness must be attributed the lack of strife; during a long visit to the fishing stations the author saw no fighting, and did not hear a single oath. No fishing is permitted on Sunday. Drunkenness and profanity are rare everywhere in Scandinavia; there seems to be absolutely no idle, non-producing, dangerous class, such as is the mainstay of vice in every other European country. At fairs and feasts there is a great deal of drinking, but the period is brief, and the fun never culminates in fighting.—*John Habberton, in Harper's Magazine for November.*

RAILROAD STATISTICS.

Poor's Manual gives some interesting railroad statistics. The mileage at the close of 1880, in this country, was 93,671, a gain of 8.2 per cent. for the year; the gross earnings were $615,401,931; net earnings, $255,193,426; each showing an increase of 16 per cent. over the previous year. The dividends amounted to $77,115,411, a gain of 25 per cent. compared with 1879—while the increased cost shown a gain of 5.4 per cent. over the year 1879. The growth of our railroad system during the past ten years has been very rapid. In 1870 there were 52,914 miles of railroad, and in 1880 there were 93,671. The gross earnings in 1870 were $9.30 per capita; in 1880, $12.27 per capita, showing that while the population has increased 23 per cent. in ten years, the gross earnings on railroads have increased in the same time 74 per cent. The freight charges on railroads have been reduced in that time from an average on the great leading lines of

1.682 cents per ton per mile, to 0.919 cents per ton per mile, showing that in the ten years the earnings have increased 74 per cent. on a decreased freight charge of 83 per cent.

A CORRECTION.

BY PROFESSOR H. A. REID.

In the REVIEW for October, page 365, occurs the "Synoptic Calendar of Creation," in which there is an important omission, but altogether my own fault. I wish to have it printed in its complete form, as connected with my article on "Creational Progress," and therefore present it here again with the omitted parts supplied.

THE SYNOPTIC CALENDAR OF CREATION.

CALENDAR TO BE READ FROM THE BOTTOM UPWARD.

THE SPIRITUAL *KINGDOM.*	7	God; angels; "ministering spirits;" "spirits of just men made perfect;" the "spiritual man" of the Bible. Also, evil spirits, "powers of darkness," the "familiar spirits" so rigorously outlawed by the laws of Moses.
THE ANIMAL *KINGDOM.*	6	All animal tissues, substances and products, including the animal, MAN, of science, or "carnal man" of the Bible.
THE VEGETABLE *KINGDOM.*	5	All vegetable growths, substances and products.
THE MINERAL *KINGDOM.*	4	All mineral substances, whether solid, subfluid, or in solution, that have never formed any part of any vitalized structure.
THE ELEMENTAL *KINGDOM.*	3	Preterrestrial elements; nebulous matter, whatever it may be; also, oxygen, hydrogen, nitrogen, ozone, etc.
THE POTENTIAL *KINGDOM.*	2	Those impalpable and imponderable *forces* in nature which physical science does recognize, but can in nowise explain or account for—as, electricity, magnetism, gravitation, heat, vitessence, will-power, volition, etc.
THE DEIFIC *KINGDOM.*	1	That Supreme Power which is the ultimate or absolute Great First Cause—however it may be conceived to exist or by whatever name called. The "Jehovah," the "Living God," the "Heavenly Father" of the Bible.

In the first publication of this calendar, as above referred to, the first two kingdoms were inadvertently omitted. It doubtless fills the popular thought without them; but for fundamental grasp and philosophical completeness, they are necessary.

WHAT VOLCANOES ARE NOT.

"What is a volcano?" This is a familiar question, often addressed to us in our youth, which "Catechisms of Universal Knowledge" and similar school manuals have taught us to reply to in some such terms as the following: "A volcano is a burning mountain, from the summit of which issue smoke and flames." This description, says Professor Judd, is not merely incomplete and inadequate as a whole, but each individual proposition of which it is made up is grossly inadequate and, what is worse, perversely misleading. In the first place, the action which takes place at volcanoes is not "burning," or combustion, and bears, indeed, no relation whatever to that well-known process. Nor are volcanoes necessarily "mountains" at all; essentially they are just the reverse—namely, holes in the earth's crust, or outer portion, by means of which a communication is kept up between the surface and the interior of our globe. When mountains do exist at centers of volcanic activity, they are simply the heaps of materials thrown out of these holes, and must, therefore, be regarded not as the causes but as the consequences of volcanic action. Neither does this action always take place at the "summits" of volcanic mountains when such exist, for eruptions occur quite as frequently on their sides or at their base. That, too, which popular fancy regards as "smoke" is really condensing steam or watery vapor, and the supposed raging "flames" are nothing more than the glowing light of a mass of molten material reflected from these vapor clouds.

The name of volcano has been borrowed from the mountain Vulcano, in the Lipari Islands, where the ancients believed that Hephæstus, or Vulcan, had his forge. Volcanic phenomena have been at all times regarded with a superstitious awe, which has resulted in the generation of such myths as the one just mentioned, or of that in which Etna was said to have been formed by the mountains under which an angry god had buried the rebellious Typhon. These stories changed their form, but not their essence, under a Christian dispensation, and Vulcano became regarded as the place of punishment of the Arian Emperor Theodosius, and Etna as that of Anne Boleyn, who had sinned by perverting the faith of King Henry VIII.—*From "Volcanoes, their Action and Distribution," in Popular Science Monthly for November.*

THE FORESTRY WORK OF THE TENTH CENSUS.

BY SYLVESTER BAXTER.

Up to the present time there has been but a vague conception of the extent and value of one of the most important sources of the prosperity of the United States. It seems the more strange when it is considered that this great item in the nation's assets is not buried in the earth, like its mineral wealth, but stands proudly upon the surface, like a mighty host, seen of all men. The entire wel-

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fare of a country is more identified with the forests that cover it than with any other feature of the earth's surface. The trees are the kindest friends of the soil; they are the guardians of its fertility; they protect the fields from devastating floods, and cherish the springs that feed the streams. Without them a land becomes an arid desert, and its people are debased to barbarism and poverty. Great desolated tracts in Asia, Africa, and along the Eastern Mediterranean were once blooming and garden-like; but when the trees were cut away the dryads avenged themselves. Therefore it is fitting that in the grand taking account of stock in the national storehouse that occurs every decade, the forest wealth of the country should at last be accorded its proper place.

Although the statistics concerning the forests of most of the European countries are generally full and accurate, the institution of the forestry division of the tenth census of the United States forms the first attempt to obtain such information by means of the census work of any country. In laying out the work of his bureau, General Francis A. Walker, the superintendent of the census, decided to undertake an investigation into the extent of the forest covering of the country as related to agriculture; into the forest wealth as related to manufactures, to railway transportation, and to the domestic supply of fuel; and into the operations of the lumbering industry as pursued in the principal districts of cutting and export. The scope of the investigation comprises the chief characteristics of the forest flora of each section of the country, an account of the various woods in their adaptation to industrial and domestic uses, and the methods in vogue in the various parts of the country for the protection or restoration of the forest growth. —*November Atlantic.*

INDIAN SUMMER.

The tranquil river glideth to the sea,
Thro' purple haze the golden sunbeams fall;
The white sails glimmer by us silently—
The hush of dreamland lieth over all.

Our spirits live like flowers in the light,
Nor feel nor fear the sting of earthly pain,
For dread the shadows of the coming night,
In peaceful rest we lie; all toil is vain.

Vain are the hopes and fears and doubts of youth,
We dream our lives away, and ask not why;
Vain all our lofty aspirations after truth;
To-day we spend in ease, to-morrow die.

Why should we work when Nature's heart is still?
Why should we strive when Nature bids us rest?
We let her influence sweet our being fill,
Hushed as a child upon the mother's breast.

—*From Good Company.*

EDITORIAL NOTES.

THE public meetings of the Winter session of the Kansas City Academy of Science will commence on the evening of the last Tuesday of this month, at which time an address will be delivered by Ermine Case, Jr., Esq., upon the subject of "The South Kensington Museum." As Mr. Case spent a great deal of his time, while in London, during 1880–1, examining this magnificent museum, his account of its treasures will doubtless be of unusual interest. Other exercises will follow, and hereafter during the winter, the meetings of the Academy will be held regularly each month.

THE *post mortem* examination of the body of President Garfield clearly demonstrates the following points: 1st, That the diagnosis of the course and final location of the bullet was erroneous. 2nd, That electricity cannot be relied upon as a means of detecting and indicating the presence of lead in the human body. 3rd, That a much more ready and direct method of finding the course of the ball would have been to make the incisions from the seat of injury, and trace it thence, than by means of the ordinary incisions over the chest and abdomen. 4th, That, notwithstanding the septic condition existing, the wound was not necessarily fatal except for the injury to the splenic artery, producing an aneurism of that vessel, the rupture of which was the immediate cause of death. 5th, That the course of the ball, passing as it did almost directly across the body behind and within less than an inch of the liver and stomach, perforating the spine between and within half an inch, respectively, of the spinal cord and the great blood vessels of the body, and finally lodging and becoming harmlessly encysted in the soft tissues beyond, was a most marvelous example of the workings of chance, and a complete exoneration of the attending physicians from any charge of lack of skill and knowledge, either medical or surgical.

MR. W. W. ALEXANDER, of this city, has recently purchased for his own use an astronomical telescope of the very best quality; manufactured by Messrs. Alvan Clark & Son, of Cambridgeport, Mass., whose reputation as manufacturing opticians is a good guaranty of its fine quality. It is an achromatic refractor with object-glass of 6.3 inches diameter, and 7 feet focus, brass tube rack and pinion adjustment for focalizing, with six astronomical eye-pieces for direct viewing; also diagonals for zenith observations, first surface prismatic eye-piece for observing the sun. The defining power of the object-glass is so perfect that it will separate double stars 0.6″ apart, the atmosphere being in a good condition; and show stars of the 13th magnitude. The cost when mounted will be about $1,500, and will be paid by Mr. Alexander alone. It will be mounted in the eastern part of the city, and used to search for comets, minor planets, sun spots, etc., to watch and study the physical constitution of all heavenly bodies. This is an acquisition creditable to our city, but especially so to Mr. Alexander, who is in moderate circumstances and almost entirely self taught.

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THE annual meeting of the Kansas Academy of Science for 1881, will be held at Topeka November 9th, 10th and 11th. The business meeting will be held at 3 P. M. on Wednesday, November 9th, at the office of Dr. A. H. Thompson. On Wednesday and Thursday evenings, popular lectures may be expected. The regular meetings for reading and discussion of papers will be held as usual, in the Senate chamber. On Friday evening, November 11th, it is expected that a reception will be given. The Mudge monument is now completed, and it is expected that many members of the Academy, under whose auspices it has been erected, will join an excursion party to Manhattan on Saturday, November 12th, and take part in the ceremony of dedicating the monument.

MR. DAVID J. MILLER, corresponding secretary of the Historical Society of New Mexico, in a circular address issued recently, gives a condensed history of its organization and the objects, and closes with an appeal to those persons having any books, pamphlets, manuscripts, journals, old letters or anything else bearing upon the history of that region, ancient or modern, to send them to him for preservation and for use in future reports of the society.

AN invitation has been extended through Professor Sylvester to Professor A. Cayley, D. C L., LL, D., F. R. S., Sadlerian Professor of Pure Mathematics in the University of Cambridge, England, to visit Baltimore and take part in the mathematical instruction of the Johns Hopkins University during the ensuing academic year. Professor Cayley has accepted this invitation, subject to the approval of the authorities of his own university; and it is expected that he will arrive in this country before the 1st of January next, and take a regular part in the instruction of the Johns Hopkins University, from that time until the close of the session in June.

COL. N. S. GOSS, of Neosho Falls, who has probably the largest and best private ornithological collection in America, numbering over 700 birds, of 350 different species, has turned over his collection to the State of Kansas, and it will soon be placed in one of the wings of the state house at Topeka. Col. Goss intends to continue making collections, and will soon visit the Pacific coast and South America for this purpose.

MALARIAL fever has been showing itself epidemically, in various parts of New England, where it has been for many years unknown.

IT is claimed that even the climate of New Mexico is changing with the advent of railroads and telegraph wires, the rainfall for the last year having been unusually great, and that of this fall notably so.

DR. SCHLIEMAN, the eminent archæologist, has arrived at Constantinople. The German embassy has asked for a firman authorizing the continuance of his excavations at Hissarlik, the site of ancient Troy.

GENERAL DICESNOLA arrived in New York on the 12th of October, from Europe, where he has been arranging to exchange the 9,000 duplicates of his Cyprian collection of archæological specimens for some of the works of art in the principal museums of Vienna, Berlin, Munich and Paris In this effort he is reported to have been very successful.

CAPTAIN HOOPER of the artic steamer Corwin, being the first explorer who has actually reached Wrangel Land, raised the United States flag thereon, August 12th, 1881, and formally named it New Columbia.

A SOUTH AMERICAN Industrial Exposition is soon to be held at Buenos Ayres, to which the United States is invited to send machinery, blooded stock, etc.

MR. CHAS. H. STERNBERG, of Ellsworth, Kansas, who has contributed several articles on the fossils of the west to the REVIEW, is now at the Museum of Comparative Zoölogy, at Harvard University, mending and cleaning his summer's collections.

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